POWER PLANT ENGINEERING

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Engineering Equipment of a Modern Hospital

DUAL SOURCES OF SUPPLY AT THE GEORGE F. GEISINGER MEMORIAL HOSPITAL, DANVILLE, PA., INSURE CONTINUITY OF SERVICE. BY J. J. BECKER*

OCCUPYING A LARGE PORTION of 13 acres overlooking the city of Danville, Pa., are the five buildings comprising the George F. Geisinger Memorial Hospital, an institution built at a cost of $500,000 and as well planned and completely equipped as money and scientific ingenuity can provide. The buildings, of which there are at present five, namely, the main hospital, a nurses' home, a power house, a garage and a research laboratory, are uniform throughout in general design and construction. Foundations are of concrete, while above the construction is of light Kittanning brick, with trimmings of gray Ohio sandstone.

The main building, in which space has been provided for seventy beds, faces due south and has a frontage of 240 ft.; its central portion is four stories in height, while the east and west wings are but two stories. To the north of the main building is the power house, a two-story structure housing also the laundry and repair

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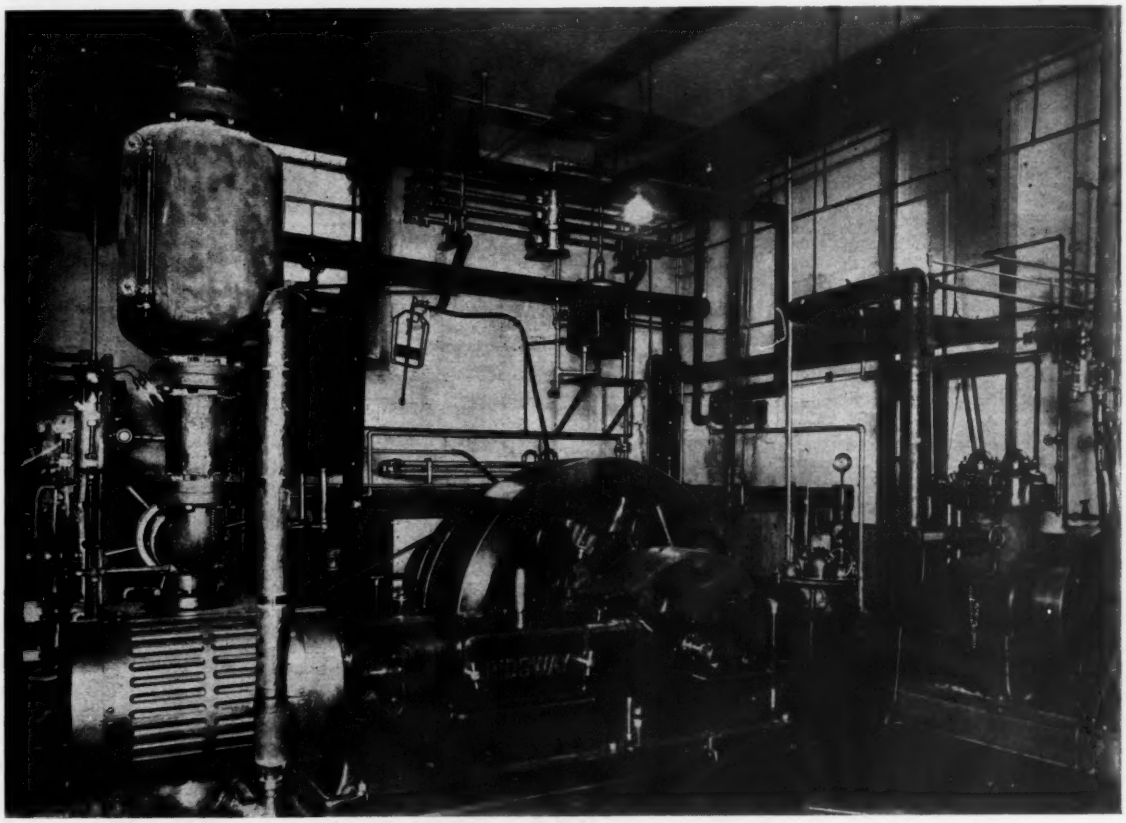


FIG. 1. CORNER OF ENGINE ROOM OF THE GEORGE F. GEISINGER MEMORIAL HOSPITAL

shop. The laundry, which is on the upper floor, is equipped, in addition to the most modern electrically operated machinery, with a large sterilizing washer for the handling of infected clothing and a steam and formaldehyde mattress sterilizer. In the basement is the power plant, the general arrangement of equipment being indicated in Fig. 2.

Steam, which is used not only for the operation of the electric generating unit and an ammonia compressor, but also for heating, domestic and general house purposes, is ordinarily supplied by two of three Keeler horizontal return tubular boilers, each rated at 100 hp. and designed for a working pressure of 80 lb. gage.

Water used for boiler feed purposes is made up of returns from the heating system and the steam condenser and is discharged into a Webster steam control or air separating tank by means of vacuum pumps. This tank, which is located on the side of the wall above the boiler feed pumps in the engine room, is equipped with a Webster float controlled pump governor and serves these pumps through the pipe connections provided for the purpose.

The general water supply is taken from a 265-ft. well in the power house by an automatically controlled 1000-gal.-per-hour Kewanee deep-well pump driven through the medium of a silent chain drive by a 5-hp. Wagner electric motor. This pump discharges the water into a 7500-gal. storage tank from where it is delivered at a pressure of 60 lb. to the various hot-water heaters and cold-water lines.

Coal is delivered to the plant in wagons and is stored in a 150-ton bin occupying the entire west end of the power house. From here it is fed to the furnace by hand.

Ashes are handled manually, also being taken from the boiler room by means of a hand operated hoist or elevator.

Steam Distribution

A 10-in. header carried along the boiler fronts connects with each of the steam generating units through the medium of 5-in. leads, each fitted with a Jenkins Bros. globe shutoff valve of like size. To this header are in turn connected four distribution branches, one of 3 in., which supplies the various pumps, two of 4 in., one for the engines and the other for sterilizing, cooking and hot water service, and one of 8 in., fitted with a 6 by 8-in. Atwood and Morrill vacuum pressure regulator and a 6-in. bypass serving the 8-in. low-pressure heating

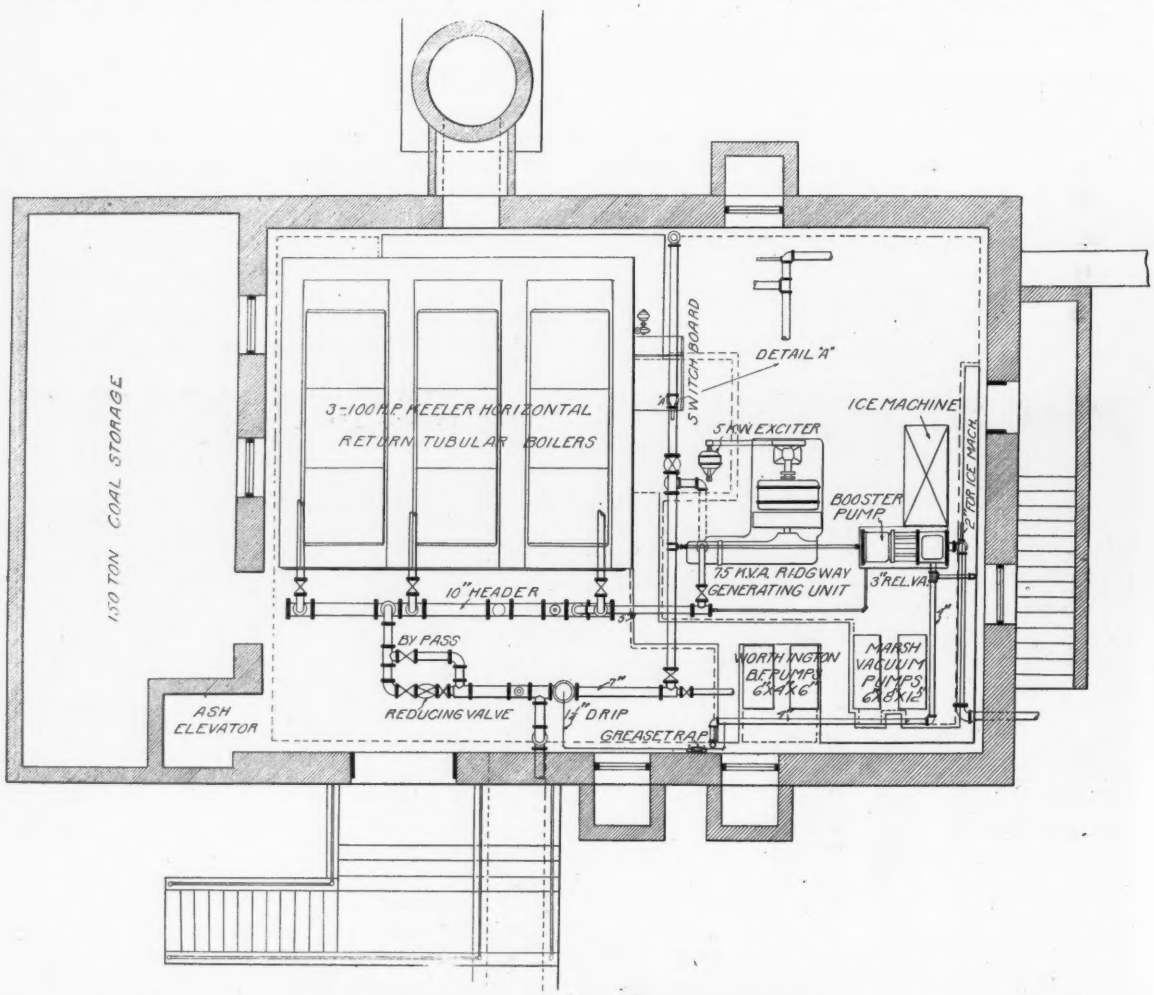


FIG. 2. ARRANGEMENT OF POWER HOUSE EQUIPMENT

main. This is also connected by means of an 8-in. tee to the main exhaust line, but with an 8-in. Webster oil separator superimposed for the removal of any oil which may find its way over from any of the pumps or the engine; a 1¼-in. drip line connects this separator with a Webster grease trap.

The 8-in. low-pressure heating main, as also all water, steam and brine lines and electric conduit, see Fig. 4, is carried to the main building through a reinforced concrete tunnel having a height of 8 ft., a width of 6 ft. and a length of about 150 ft. All pipe lines, as shown, are placed on angle iron shelves, each fitted with roller bearings to accommodate more readily the slight movements of the pipe bound to occur, due to expansion and contraction. Electric conduits are either suspended from above or attached to the side of the opposite walls in close proximity to the ceiling.

The heating system is of the Webster type. Under ordinary conditions of operation a vacuum of 12 is maintained by one of two 6 by 8 by 12-in. Marsh simplex vacuum pumps installed for the purpose. Each of these is fitted with a Webster vacuum pump governor.

All high-pressure steam lines are fitted with Atwood-Morrill steam traps, which discharge into the main re-

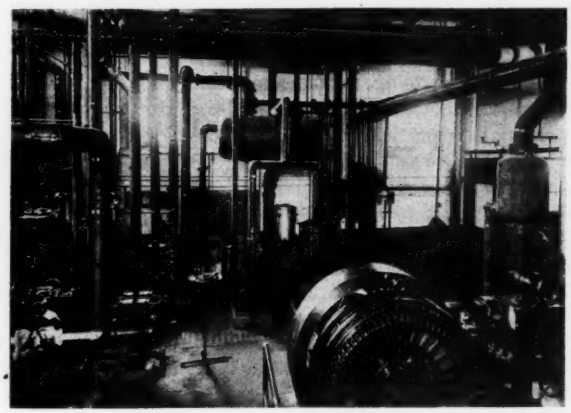


FIG. 3. ENGINE ROOM, SHOWING GENERATING UNIT AND PUMPS

turn of the heating system.

Jenkins Bros. valves are used throughout the installation.

Electric Service Supply

In addition to meeting the requirements of an average 25-kw. lighting load, electric current is also employed for the operation of motors driving various machines about the hospital buildings, such as a 12 by 16-in. American Rotary Valve Co.'s vacuum cleaner, the laundry machinery and the elevators, of which there are two, one of 2000-lb. capacity, used for passengers, and one a 1500-lb. machine, employed for freight service only. These, together with a dumb waiter serving the diet kitchens, are under automatic electric control.

Two sources of current supply are available, an outside service supplied at 2500 v. to three 30-k.v.a. transformers stepping down to 110 and 220 v. and a 75-k.v.a. 250 v. Ridgway alternating current generating unit in the engine room. Ordinarily, at present, central station current is used, except during those periods of heavy demand for exhaust steam, when the operation of the generating unit proves desirable, or at any time this source of supply should fail. In such an event, the operators are immediately notified by a number of red signal lamps located in various conspicuous parts of the plant, thus enabling them to place the private plant into operation with but a minimum interruption to service.

Elaborate telephone and signaling systems have been installed. At the side of a sixty-line private switchboard in the office there has been erected a second board of special design, on which are placed "in" and "out" annunciators and from which the operator is able to tell just what members of the staff are in the building. On the same board is mounted a telegraph key, by means of which the operator may send code signals over any one

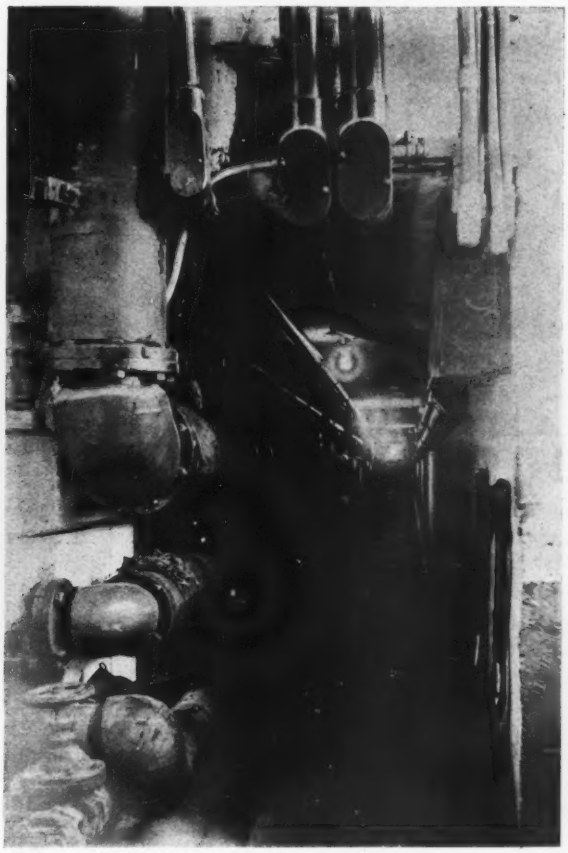


FIG. 4. INTERIOR OF TUNNEL CONNECTING POWER HOUSE AND MAIN BUILDING

or all eight separate circuits, connecting with 50 tickers located in various departments of the five buildings. Each member of the staff has his or her own signal and by this system can be found at a moment's notice.

A complete system of nurses' call signals has been installed by the Holtzer-Cabot Electric Co, and every bed in the hospital has its own button and number. Colored lights are used as signals and a pilot board in the head nurse's office in the administration wing indicates at all times the promptness or lack of it with which calls are answered by the nurses on duty. Each private room is equipped with long distance telephone connections.

Refrigerating Equipment

In institutions of this type and size, naturally, considerable quantities of food are held in storage and require low temperatures for their preservation.

For this purpose there have been installed nine refrigerators having a combined cubical contents of 180 cu. ft., and three cold storage rooms, one of 144 cu. ft. and the other two of 384 cu. ft. each. The former are maintained at a temperature of 40 deg. F. and the latter at 32 deg. F.

Brine is the cooling medium employed. This, after being reduced in temperature to about 10 deg. F. in a tank 13 by 7 by 4 ft. containing two sections, each five pipes high and having a total length of 100 ft. of 2½-in. pipe, is circulated through the system by a 5¼ by 3½ by 5-in. Worthington duplex pump.

FIG. 5. STEAM GENERATING UNITS

The York compressor shown in Fig. 1 has a rated capacity of eight tons and is direct connected to and driven by a 8 by 10-in. York vertical steam engine.

Cracks in Concrete Pavements

A SERIES of investigations recently concluded in the office of the Public Roads Bureau of the Department of Agriculture gives some valuable data as to the causes for cracking in concrete pavements. The full report is given in Bulletin 532 of the Department of Agriculture, which can be obtained free on application to the Department, Washington, D. C.

Some of the conclusions are, that neat cement when allowed to dry contracts at first rapidly, then more slowly, the amount of contraction varying with the cement, the size of the specimen and the condition of air in which the drying takes place. At the end of 28 days, the amount of contraction is about 0.1 per cent, and at the end of 6 mo. about 0.2 per cent.

For cement mortar drying in warm air, at the end of 28 days the contraction is about 0.045 per cent for a 1:2 mix or a 1:3 mix, and at the end of 6 mo. about 0.078 for a 1:3 mix, and 0.085 per cent for a 1:2 mix. When hardening in water, the mortar expands instead of contracts, the expansion being 0.01 per cent for a 1:3 mix and 0.017 for a 1:2 mix at the end of 28 days, and at the end of 6 mo. 0.013 for a 1:3 mixture and 0.02 for a 1:2 mixture.

For concrete with a mixture of 1:2:4 or 1:3:6, the contraction when drying in warm, dry air is from 0.02 to 0.04 per cent at the end of 28 days, and from 0.04 to 0.07 per cent at the end of 6 mo. When hardening in water, the expansion is about 0.01 per cent at the end of 28 days, and about the same at the end of 6 mo.

The richer the mixture, the greater will be the change in length. Concrete alternately wetted and dried will expand and contract owing to these causes; but the expansion due to wetting is more rapid than the contraction on drying, and thoroughly dried specimens do not expand to their original wet length when immersed. Concrete when stored in the outer air and exposed to the weather does not contract to the same extent as when hardening in warm, dry air, unless the outdoors air is very dry.

A waterproof covering, such as coal tar, will prevent the rapid change in moisture content, and greatly retard both expansion and contraction. Reinforcement decreases, but does not prevent, the shrinkage and expansion of concrete due to moisture, and has no effect on temperature changes; but it seems to distribute the cracks and keep them small.

In designing joints for road or pavement construction, the temperature at the time of construction should be considered. Cold-weather construction requires a full allowance for temperature expansion and, on wet sub-bases, for moisture expansion also. Hot-weather construction theoretically requires no joints at all, even with wet sub-bases, as the temperature construction exceeds the moisture expansion; but the difficulty of keeping cracks clear probably renders joints imperative. Shrinkage of ¼ in. in 50 ft. is a safe allowance for contraction due to drying.

Smaller Boiler Tubes

As a result of tests on the transmission of heat by the Bureau of Mines, it has been determined that the chief resistance to transfer of heat from gases to water is at the surface of the metal in contact with the gases. Any amount of heat that can be gotten from the gases into the boiler metal will easily be carried on and transmitted to the water, if the water side of the boiler surfaces is clean.

With a given temperature of gases and a given boiler pressure, the capacity of the heating surfaces can be increased by increasing the velocity of the gases passing over the boiler surfaces.

Efficiency can be increased, therefore, by making the tubes smaller, and, in water-tube boilers by placing them closer together, so that gas layers are thinner and the average distance from the hot particles of gas to the metal is made shorter. To keep the total area for gas passage the same, a larger number of smaller tubes can be used, but tube diameter and spacing should not be so much reduced as to interfere with the water circulation.

The secret of making light engines is leaving off metal that is not needed and using sections of great strength and stiffness, but with small areas.—The Gas Engine.

Bearings---III

CUTTING THE OIL GROOVES; ALLOWABLE PRESSURES

TO DISTRIBUTE the oil properly and at the same time to collect that which would otherwise run out at the ends of the bearing and return it to some point where it may again be of some use, it is necessary that all but the very smallest bearings be provided with some form of oil grooves. The design of grooves depends much upon the opinion of the man doing the work, but as long as they satisfactorily perform the functions enumerated above no hard and fast rules can be laid down as to the exact way in which these grooves shall be cut. Where the oil is fed drop by drop through a hole in the cap, the scheme shown in Fig. 1 will distribute the lubricant as well and as thoroughly as any other. In the lower half of such a bearing only shallow grooves parallel to the ends of the shell should be cut, these to intercept the oil which would flow out at the ends and direct it to the counterbored recesses where it may again be made of use.

Grooving developments recommended for single and double ring oiling bearings are indicated in Figs. 2 and 3, respectively, the depth of the grooves varying from 3/32 to 5/16 in., according to the size of the bearing. Comparatively deep grooves cut near the ends of the shell and parallel to the periphery of the shaft or recesses provided in the housings and properly drained to a basin below will prevent the oil creeping along the shaft. And in order to prevent a scraping action otherwise present, to provide a recess in which surplus oil may gather and as a further means of distribution, the shells should be counterbored at the joints, such counterbore extending to within ¼ to ½ in. of the ends of the bearing.

For crosshead shoes, the design shown in Fig. 4 is employed extensively by engineers for both old and new work. This shows the face of the shoes with the grooves arranged in the form of a diamond, the lines of which cross from 1 to 2 in. from the end as indicated by the shaded portion, which should be cut to a depth of from 3/16 in. and a width of ¼ in. The end may be broken away as shown. With the engine in operation, these open spaces at the ends of the diamond of the lower shoe collect the oil naturally lying on the bottom slide, and, due to the travel of the crosshead, force it into the grooves and again out at the other end where the reverse process is repeated in the return stroke. This insures all parts of the slide being served with oil at every stroke, and also to a very great extent prevents splashing.

FIG. 1. SECTION OF OUTBOARD BEARING, SHOWING OIL GROOVING AND COUNTERBORED RECESSES

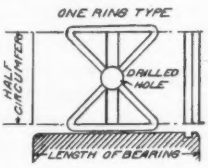


FIG. 2. OIL GROOVE LAYOUT FOR SINGLE RING BEARING

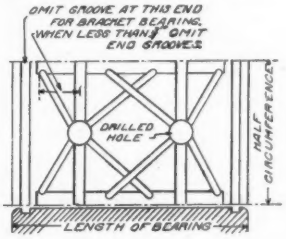

OMIT GROOVE AT THIS END FOR BRACKET BEARING, WHEN LESS THAN 8" OMIT END GROOVES
DRILLED HOLE
HALF CIRCUMFERENCE
LENGTH OF BEARING

FIG. 3. OIL GROOVE LAYOUT FOR DOUBLE RING BEARING

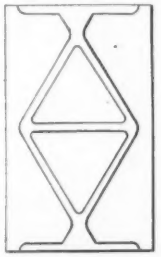


FIG. 4. OIL GROOVES FOR CROSSHEAD SHOES

TABLE I. LENGTH-DIAMETER RATIOS FOR BEARINGS

Type of Bearing	L/D
Marine engines	
Main bearings	1 - 1.5
Crank pin bearings	1 - 1.5
Stationary engines	
Main bearings	1.5 - 2.5
Crank pin bearings	1
Wrist pin bearings	1 - 1.5
Generator and motor bearings	2 - 3
Ordinary shafting	
Heavy - fixed bearings	2 - 3
Light - self-adjusting bearings	3 - 4

TABLE II. ALLOWABLE BEARING PRESSURES—MARKS

	Pounds per Square Inch
Main engine bearings	375 - 400
Main engine crank pins	400 - 500
Steam turbine bearings	85 max.
Electrical Machinery	
Horizontal steam turbine bearings	40 - 60
Vertical steam turbine steps	200 - 1000
Generator and motor bearings	30 - 80
Main bearings of engines driving generators	40 - 80
Gas Engines	
Main bearings (total load)	500 - 700
Crank pin bearings	1500 - 1800
Crosshead pin bearings	1500 - 2000

Crankpins are generally oiled through the pin proper by means of a duct drilled as illustrated in Fig. 5. A shallow groove is then cut in the surface of the pin parallel to its axis, and reaching almost to the ends of the bearing. No grooves should be cut in the boxes, but the edges where they curve together should be counterbored.

Bearing Pressures

Of greater importance than the compressive strength of the bearing metal is the pressure commercial lubricating oils will endure at low speeds without breaking down. And while the pressure capable of being withstood by the ordinary grades of oils varies from 500 to 1000 lb. per sq. in., where the load is steady, it is not advisable to load the ordinary bearing to this extent since it is only under favorable circumstances that the oil film will stand this pressure without rupture.

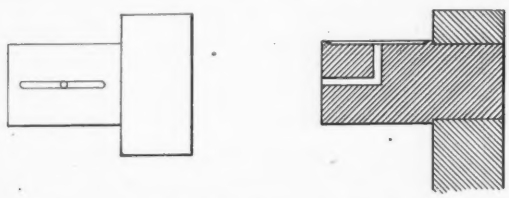


FIG. 5. INTERNALLY OILED CRANKPIN SHOWING PASSAGES AND GROOVES

W. H. Scott in the Engineering Digest offers a series of formulas based upon the experimental work of Tower, Lasche and Stribeck. These are as follows:

For main bearings of double-acting engines ..... $p = 750\ D^{\frac{1}{4}}/N^{\frac{1}{4}}$

For main bearings of double-acting horizontal engines ..... $p = 660\ D^{\frac{1}{12}}/N^{\frac{1}{4}}$

For main bearings of single-acting 4-cycle gas engines..... $p = 1350\ D/N^{\frac{1}{4}}$

For crankpins of vertical and horizontal double-acting engines ..... $p = 1560\ D^{\frac{1}{4}}/N^{\frac{1}{4}}$

For crankpins of single-acting 4-cycle gas engines ..... $p = 3000\ D^{\frac{1}{4}}/N^{\frac{1}{4}}$

For dead loads with ordinary lubrication ..... $p = 400\ N$

For dead loads with forced lubrication ..... $p = 1600\ N^{-\frac{1}{4}}$

p = allowable pressure in pounds per square inch of projected area; D = diameter in inches; N = revolutions per minute.

F. W. Taylor in the 1905 Transactions of the A. S. M. E., as the result of an investigation of line shaft and mill bearings that were running near the limit of durability and heating, yet not dangerously, gives the formula $PV = 400$, where P is the pressure in pounds per square inch of projected area and V is the velocity of circumference of journal in feet per second.

The formula is applicable to bearings in ordinary shop or mill use on shafting intended to run with the care and attention which such bearings usually receive, and gives the maximum or most severe duty to which it is safe to subject ordinary chain or oiled ball and socket bearings which are babbited.

Allowable bearing pressures commonly met with in practice are indicated in Table II.

Power Plant Instruments as an Investment---III

Savings to be Effected by Measuring and Weighing Feed Water and Coal Consumption. By M. A. Saller

COAL and water represent the most expensive items in connection with power plant operation, and therefore any attempt at economical power production would be dependent upon an accurate and continuous record of the rate at which these two items are consumed. In other words, they are the raw materials from which power and steam are generated, and upon which, therefore, the cost of production is directly dependent.

Without a record of the water and fuel consumption, an accurate analysis and comprehensive study of operating conditions, power costs and distribution is impossible.

While the installation of a good feed-water meter and a system for weighing coal is looked upon by many engineers as a luxury, it is only required to consider some of the real and actual savings which they can lead to in order to be convinced of the necessity for their use in any plant that purports to be well managed and operated.

The fuel bill represents from 60 to 70 per cent of the total cost of power, and a large percentage of this is wasted through preventable causes. From 10 to 40 per cent of the entire fuel cost is wasted in average practice, the losses being divided somewhat as follows: Loss because of unsuitability of coal for the condition runs from 10 to 15 per cent; the loss of coal through the grates runs from 2 to 5 per cent; loss due to improper firing may run from 8 to 10 per cent or even more; loss due to air leaks, poor draft, etc., can amount to 10 per cent; defective baffling and collection of soot on passage may cause another 4 or 5 per cent, scale 5 to 10 per cent, and excess radiation from 2 to 3 per cent.

Among the foregoing losses, at least 50 per cent of them are preventable and can be eliminated if the cause and effect are indicated and made known. While many boiler plants operate with a boiler efficiency of 60 to 65 per cent, and some below 50 per cent, proper operating methods would result in an increase of overall efficiency to 75 or 80 per cent, or an increase over old conditions of 25 or 50 per cent; 25 or 50 per cent of the fuel bill for any one season is quite a large sum of money.

The records from a feed-water meter showing the amount of water evaporated by the boilers, i.e., the amount of steam generated, points out the load characteristics of the entire plant. It shows where the peak loads and the usually wasteful low loads occur, and often enables the operator so to adjust working conditions as to allow the plant to be operated continuously at a fairly constant and efficient rate which is conducive to the most economical results. Very frequently it also enables the operator to carry more economically on a less number of boilers at high rating a load that was formerly distributed over a great number of units at a sacrifice of efficiency.

The record of the amount of water evaporated, taken in conjunction with the amount of coal consumed, also

enables the operator to establish rates of cost per pound of steam per horsepower for comparison with previous costs, and for use in distributing charges for power, steam, etc.

By means of the feed record chart and the amount of coal burned under the furnace it is possible to determine the evaporating efficiency of the boilers, the amount of water evaporated per pound of coal, all highly important items for comparison and record purposes. Figure 1 is a copy of a feed water chart taken at the time the feed-water meter was installed, when an evaporation of 7.5 lb. of water per pound of coal was being obtained. Figure 2 shows a chart taken from the same meter several months later, when an evaporation of 10.5 lb. of water per pound of coal was being obtained, a clear saving in fuel of from 40 to 50 per cent, due to the information offered by the meter records. A much more uniform rate of feeding and a more constant set of operating conditions will also be noted.

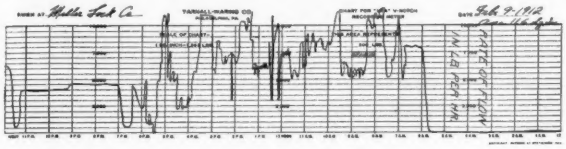


FIG. 1. FEED-WATER CHART JUST AFTER INSTALLATION OF METER

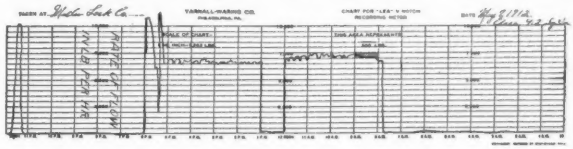


FIG. 2. FEED-WATER CHART FROM SAME METER AS FIG. 1 SEVERAL MONTHS LATER

By showing a decreased rate of evaporation per pound of coal compared with previous best records, the feed water and fuel records warn the operator to be on the look-out for some condition which is resulting in the waste of fuel. It may be that the boiler tubes have become coated with scale or soot, or air leaks through the setting may have developed, or faulty draft conditions prevail, poor grades of coal are being furnished by the coal company, or irregular firing may be done. One concern operating about 2000 hp. of boiler capacity found, upon checking the records from their feed-water meter and fuel consumption, that 10 to 20 per cent of their fuel was being wasted because of inefficient stokers which allowed unconsumed coal to pass to waste, and which permitted excessive infiltration of air. After changing over to other stokers the load was then carried on 1200 hp. of boilers at forced rating at a considerable saving in fuel, totaling some $25,000 for the year.

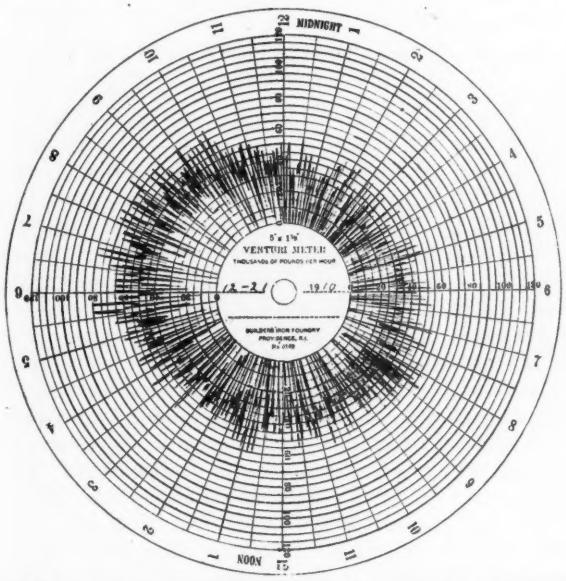


FIG. 3. CHART SHOWING FLUCTUATION IN THE AMOUNT OF FEED WATER SUPPLIED

The judicious application of the information given on a record chart will also enable the operator to determine which grade of coal can be used to best advantage under his conditions. Some years ago a test at a local plant showed that it was more economical for one power user to purchase coal at $2.75 per ton than to use another grade of coal selling for only $2.25 per ton. It was found that the higher priced coal evaporated 9.0 lb. of water per pound of coal, while with the cheap coal the evaporation was only 7.1 lb., with increased costs for handling because of the greater quantity of ash present, and because of the tendency to clinker possessed by the cheaper coal.

Different methods of firing also lead to an increase or decrease in power costs and trial runs operating under various methods of firing will soon enable the operator to determine which set of conditions is most favorable. The installation of metering equipment makes it make convenient to run these tests, and hence causes this checking up to be done at more frequent intervals.

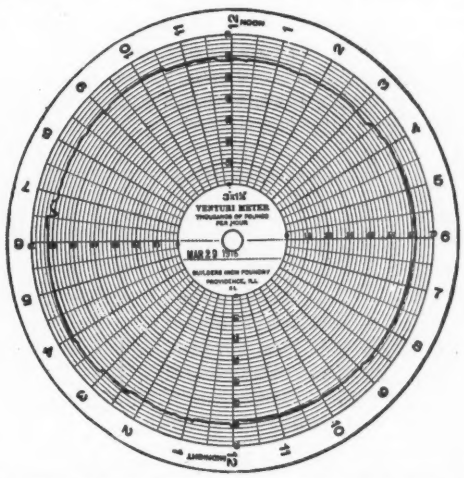


FIG. 4. FEED-WATER CHART FROM A WELL OPERATED PLANT

It is also a fact that the firemen in plants where a graphic chart record of boiler performance is kept, and consequently where there is a check on the efficiency of firing, are likely to use more care and are encouraged to better their previous records.

The feed-water chart also points out forcibly any great irregularities in boiler feeding. In some plants

it is customary for the firemen to fill up the boilers with water and then give no further attention to them until the low-water mark is reached, when the pumps are speeded up and the boiler is refilled. This state of affairs is undesirable for several reasons. A comparison in feeding conditions will be noted from Figs. 3 and 4, Fig. 3 showing the fluctuating method of feeding, while Fig. 4 shows a chart taken in a plant where careful attention is paid to securing an even rate of flow to the boilers.

The permanent records of feed water and fuel consumption are also of assistance in deciding upon future enlargements and extensions, and frequently save the owners expense for installing additional equipment which might not be needed if the conditions were properly known. One plant running 1000 hp. of boilers had reached their limit of capacity and it was decided to double up by installing another 1000 hp. Before this was done, however, a meter was installed which showed that instead of needing the additional 1000 hp., it was only necessary to install another 500 hp., since the original installation was capable of generating 50 per cent more steam than had previously been obtained from them. The saving in the purchase price and installation cost of this extra 500 hp. of boilers would have paid for the entire cost of the meter many many times over.

Take for example a 1000-hp. plant using 25 tons of coal in a 10-hr. day. At present-day prices for coal, say, $4 per ton, and basing our estimate on 300 days per year, the annual coal bill would amount to $30,000. A metering equipment for this plant for the feed water and for the coal would amount to not more than $2500, figuring on installing the best equipment. On this basis, it would be necessary for this apparatus to effect a saving of only, say, 10 per cent of the fuel bill in order to pay for itself in the first year, and considering the possibilities as outlined above, especially in paragraphs 4 and 5, this is well within the range of possibilities.

For small plants up to, say, 400 or 500 hp., the expense of installing the most expensive equipment would probably not be warranted because the smaller plants are not operated at such a fine degree of efficiency as the larger stations. Therefore, a more inexpensive meter, and some simple method of weighing and keeping track of coal consumption could be used, in which case an accuracy within not more than 5 per cent would be satisfactory; however, in the larger plants where greater efficiency is obtained, automatic weighing machinery for the coal and accurate meters for the feed water, registering to within 1 or 2 per cent of absolute accuracy will be found worth while investments.

Characteristics of Mechanical Stokers*

ADVANTAGE OF STOKERS OVER HAND FIRING; USE OF NATURAL AND FORCED DRAFT; TYPES OF STOKERS SUITABLE TO DIFFERENT GRADES OF COAL. BY E. L. SULLIVAN

STATISTICS up to January, 1917, show us 55,580,000 hp. in the U. S. and this has increased for the last 15 yr. at the rate of 2,000,000 hp. a year. Considering that this boiler horsepower is made at about 60 per cent efficiency which is higher than the average for the ordinary hand-fired boiler, the actual horsepower which is lost, due to the incomplete combustion, leaky boiler settings, flue gas losses, etc., is about 37,020,000 boiler hp. With the increasing cost of coal and its diminishing qualities, the attention of the business man and engineer has been turned more and more to the neglected and inefficient boiler room. He is finding that to run his plant efficiently he must have an up-to-date method of firing his boilers. The solution of this problem is the mechanical stoker, which increases the efficiency from 60 per cent to between 70 and 80 per cent or a saving of about 13,883,000 boiler hp., or about ¼ the total available horsepower of this country.

The high efficiency of a stoker can be attributed to the fact that we have an equal and proportionate distribution over the entire grate surface which gives complete combustion. The feeding of coal, and the clearing of the fires is not spasmodic as in hand fires, but continuous. There is no large excess of air allowed to enter across the fire, as there is no need of opening the fire doors, the coal being automatically fed. In the forced draft installations, a high temperature at the stack is not required, and so a large saving is made in the flue gases.

The natural draft installation depends on the difference in temperature between the gases at the base of the stack and the temperature outside. Thus we must get as high a temperature as possible, consistent with economy, at the base of the stack. With forced draft we depend on the fan for the draft, and the stack is useful only for carrying off the gases. We reduce the draft over the fire to zero by partly closing the damper, thus causing the gases to remain among the tubes of the boiler until their temperature becomes a minimum. Added to the advantage of the design of the mechanical stoker, the feeding of coal and the removing of the ashes automatically reduces the help in the boiler room so materially that this is by no means the least factor that is leading to the universal adoption of the stoker.

Another point that is well to consider is smoke prevention, which is characteristic of most stokers. This has become of great social importance, especially in cities, and has led to the making of strict laws with heavy fines for offenders. These laws have become necessary, because the saving made by smokeless combustion is hardly enough to induce coal users to take the trouble to prevent it.

The business man is especially interested in this period of business prosperity in the increased rating that he can obtain in his boiler, especially from a forced draft installation. He can obtain from the boiler plant, which was adequate for his old business, over double the capacity without buying new boilers which at the present time is not possible without a long delay, and with very little, and in some cases no inconvenience, as many stokers can be erected and put in operation during a

*From an address before the Mass. Institute of Technology.

week-end. He has, finally, a paying proposition, as a good stoker will pay for itself in less than a year in its efficiency and saving.

Now to be more specific, stokers may be divided into two classes, natural and forced draft. The advantages of the natural over forced draft is in a plant where stokers are installed under boilers which have previously required a large and high stack or chimney. We have in this case no other expense than the actual installation of the stoker. In the case of forced draft we would have to install fans, engines, and turbines to generate the draft, and ducts to convey the air to the furnace. The stack would probably be too large, and would require throttling to obtain a balance draft over the fire. But in another phase of most boiler plant problems, the advantage of forced draft over natural draft, is so overwhelming that the added expense and trouble is not to be considered. With a natural draft installation, we are limited as to the amount of coal we can burn per square foot of grate surface, by the maximum draft the stack will give, and this depends on its size, height, and relative temperature inside and out. If unforeseen peak loads should come on the plant, nothing can be done; while, with a forced draft installation, the mere speeding up of the fan will increase the rate of combustion three times, and even higher the rating of the boiler.

Another classification of stokers, based on the method of feeding the coal, is underfeed, overfeed, and chain grate.

In the underfeed stoker the fuel bed consists of three layers, the lower or green coal, intermediate above is coal in the process of coking, and uppermost is the incandescent fuel. Each charge of coal from beneath preserves this formation. As the coal is gradually pushed up by each succeeding charge the gases are distilled off, and must pass up through the incandescent bed above. Air is admitted at either side of the retort or fuel magazine, and mixing with the gases supplies the oxygen necessary for combustion. In the American stoker the coal is fed into the retort continuously by a tapering, helical screw, or worm which distributes the coal evenly the full length of the fire. Around the upper edge of the retort are the tuyere blocks through which air is supplied to the green coal. The burnt coal is gradually pushed to the sides, and at regular intervals the furnace is cleaned through the fire doors. This type of stoker is especially adapted to heating furnaces, but is still largely used under boilers. A similar type is the Jones underfeed, the only difference being a steam pusher instead of a screw.

In Type "E" stokers the coal after being carried into the retort by means of a sliding bottom and raised up by coal pushers is fed down to either side by means of alternate, moving, air-cooled fire bars. Between these fire bars, as well as at the retort, preheated air which has become heated in passing through and thus cooling off the fire bars passes up through the fire. This gives an equal relative distribution of air and coal over the entire grate. The fire bars, which are set at an angle of 15 deg., move so that burning coal is gradually fed to the sides, and by the time it reaches the ends of the bar, it is ash. This ash is allowed to collect on dump plates, and is periodically dropped, depending on the ash in the coal, and the rate of combustion, into the ash pit or hopper below. A special feature of this stoker, which insures complete and smokeless combustion, is that air is allowed to enter across the fire at both the front and back. This air can be regulated in accordance with the volatile matter in the coal. The fire in this stoker is always clean, as any ash forming on the fire grates or bars, is pushed on to the dump plates. This stoker can be hand fired, which makes it very desirable in isolated boiler plants which shut down completely over Sunday, and would have no steam to start stokers.

The gravity underfeed stoker is represented by the Taylor or Westinghouse. The coal is fed from the front toward the bridge wall on an inclined plane, being accelerated by rams or pushers operated by a multiple crank shaft. The ashes are dumped into the ash pit at the bridge wall across the entire width of the furnace. Owing to the width of the retorts and the number of them, and due to the fact that no air can be admitted at these points, it is necessary to carry a very deep fire bed in order to get an equal air distribution at the surface.

The principal stokers of the overfeed type on the market are the Roney and Murphy. In the Roney the grate bars extend across the furnace in a series of steps down which the fuel slides toward the bridge wall. Each grate bar is hung or pivoted at the end near the top, and has a rounded lug on the bottom that rests in a groove in the rocker bar. This gets a slow reciprocating motion from a small steam engine which tips the grate bars so that the upper side is inclined downward to make the fuel slide, and then rights them to check the motion. The coal from the hopper is pushed forward by a pusher onto the grates. The ash collects on dump plates, and is dumped at intervals by means of a lever in front.

In the Murphy stoker coal is fed in at either side, the full length of the furnace, and moves by gravity toward the center. At the center is a clinker grinder which works continuously, and deposits the ash into the pit below. They are now installing these stokers under forced draft.

The stoker, which is the simplest in principle, is the chain grate, and it is entirely automatic. The grate surface is made up of a series of links which form a band the full width of the furnace. The coal is fed on to the grate at the front, and passes under white hot ignition arches. Here the gases are distilled off, and passing between the heated arch and over the fire bed, are consumed. These grates have been very successful on certain grades of coal such as the Illinois and Iowa which are high in volatile. In some coals, as the above, a good smokeless condition has been obtained while with other fuels the results have been unsatisfactory.

The successful use of the forced draft and the efficient combustion of the lower grades of anthracite coal are accomplished by the Coxe stoker which is of the chain grate type. The forced draft is so arranged that it can be regulated to suit the varying conditions of the fuel bed as they develop in the front, middle, and rear sections of the grate. The 2, 3 or 4, or rice, barley, and

silt sizes of anthracite coal are particularly adaptable for use on this stoker. The small size of the coal renders it very susceptible to ignition, and while forming a close fuel bed, tends toward an almost perfect air distribution. With this fuel which only a few years ago was treated as refuse, wonderful results are being obtained. A noteworthy feature of the design is that the link can be removed and replaced while the stoker is in operation. Coke breeze has also been burned successfully on this type of stoker.

Plant Remodeling Under Difficulties

By the Sufferer

FOR several years I was chief engineer at a plant where we carried a moderate amount of cold storage and made a little ice. The owner was a "recently rich," but always autocratic individual, barely able to read and write, yet cocksure that nobody knew more than he about everything, and few knew as much about anything.

Demand increased, and it was decided to double the storage capacity without increasing the power end, but relocating the machinery to do away with some shafting and belts. There the trouble began.

I studied the problem, gathered information about other plants and drew the rough plans for the new building and rearrangement, which were turned over to an architect to be refined and completed. My ideas, and those of the architect, were overridden roughshod by the owner; but a contract was finally worded to suit him, by means of reading and explanation by his wife and relatives, and duly signed.

I was to look after the erection of the building and move and erect the machinery on the foundations. When building started, the fun began. I had ordered about $2.50 worth of rough lumber for templates, and the Boss, seeing it delivered, called me over.

"What's all this wood doing here?" he demanded. "These foundations are all to be concrete."

I explained the use of the templates for locating anchor bolts and holding them while pouring the concrete; also the need of pockets for nuts. But he exploded. "By the —— —— ——, I've built all kinds of foundations for houses and bridges and chimneys, and concrete is all you need. Just bring about 1 in. of cement up over that groove in the bottom of the sill," (the oil gutter around the engine base), "and that's all you need to hold her till she freezes hell over."

The argument got nearly as warm as the place referred to, but the rest of the firm finally got instructions for me to go ahead as originally planned.

The next defect discovered by the owner was a recess in the wall left for exhaust pipes to the roof. "Now, that'll make that wall too weak, and the whole ——— ——— shebang will be comin' down on top of yer. Fill it up solid. Make a good, durable wall and carry them pipes up in the middle of the building where the frost won't get at 'em."

That order didn't seem to involve any danger of future operating difficulties, so, remembering the previous argument, the recess was filled and the pipe run changed. Cost, $150 for extra pipe and fittings, to say nothing of labor. And I have been sorry ever since that I didn't quit right there.

Shortly after we started the reinforced concrete floors, and the electrical contractor began to place his conduit pipe for the wires and cables, so that they could be buried in the concrete. "But you can't get wires into them d—d dead and buried pipes after the concrete is down. You got to show me before you go ahead sech a fool way as that."

And the result was the whole work held up 2 weeks before we could get him to let it go that way. We couldn't explain, or even show him how any wires could be got into those pipes. He knew better, and he wasn't anybody's fool, and we needn't try to tell him what he knew couldn't be done—and so on, with the air of a blue haze and smelling like fumigating candles.

Oh, well! It got finished after a time, and by working night and day I had the plant in running order in time for the summer season.

Then—the boss came in one day and said the plant was so well arranged and in such good condition that he could get along with an engineer he could hire for $12 a week instead of the $30 I was getting. Right then I started for the office for my pay, but the rest of the firm and the architect argued me into staying until the building and piping were finished, and a man broken in to take my place.

He didn't stay long. A truck driver is running (?) the plant now, and frequently I am called over to put it back into running condition, for which the owner pays the firm for which I now work 80 cents an hour and expenses.

I could go back any time, but what's the use?

That between 71,000 and 75,000 tons of available recoverable potash—about ⅓ of the quantity normally consumed in the United States, exists in the dust passing through or retained in the flues of the cement manufacturing plants of the country is indicated by analyses made by the Bureau of Soils of the United States Department of Agriculture, according to a recent publication, Department Bulletin 572. By increasing the percentage of potash volatilized, by the addition of substances which will not affect the quality of the cement, the recoverable potash in flue dust can be increased to more than 100,000 tons annually, or nearly ½ of the normal consumption of potash in the United States, according to the bulletin.

Numerous plants have installed electrical precipitation equipment to recover the flue dust, and are finding the installations good investments, the bulletin declares. Some plants are recovering 95 per cent of the potash present in the raw materials fed into the furnaces.

The dust recovered in the flue stacks, connecting kilns, and precipitation apparatus is about 4.5 per cent potash, while that recovered from the precipitation apparatus itself is about 11 per cent potash. The dust may be used as a source of cement material, may be disposed of as collected for use as a fertilizer or in fertilizer manufacturing, or may be bleached to prepare concentrated potash salts.

Electrical Machinery and Appliances

For Generating, Transmitting and Using Current

Lightning Protection---II

TYPES OF APPARATUS EMPLOYED AND THEIR PRINCIPLE OF OPERATION. BY TERRELL CROFT

NON-ARCING metal cylinder protectors (Figs. 10 and 10A) may be used on alternating-current circuits operating at pressures below 300 v. The metal cylinders are usually composed of a copper-zinc alloy. In an alternating-current circuit, an arc, established by a lightning voltage, will not be maintained between these cylinders by the power current. The reason is that the arc will extinguish when the power alternating-current wave passes through zero. The zinc in the alloy vaporizes at a relatively low temperature and this vapor tends to quench the arc. There is also a rectifying normal voltage. In series with the gaps is arranged a resistor to limit the dynamic (generator) current which tends to flow to ground after an arc has been established through the gaps by a lightning discharge. Figure 12 shows how three protectors, P_1, P_2 and P_3, of this type may be mounted on a pole for transformer protection. L_1, L_2 and L_3 are the line wires.

The graded-shunt-resistance protector, the principle of which is illustrated in Fig. 13, consists of a series of spark gaps (G_1 to G_{14}) associated with resistors which are shunted around them. Protectors of this general

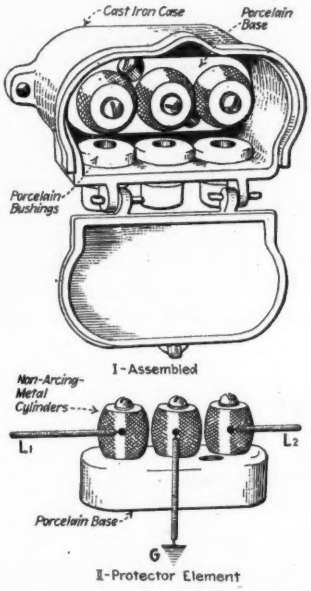


FIG. 10. DOUBLE-POLE, NON-ARCING METAL CYLINDER PROTECTOR

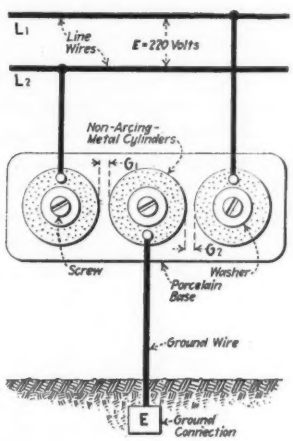


FIG. 10A. ILLUSTRATING THE NON-ARCING METAL GAP PROTECTOR

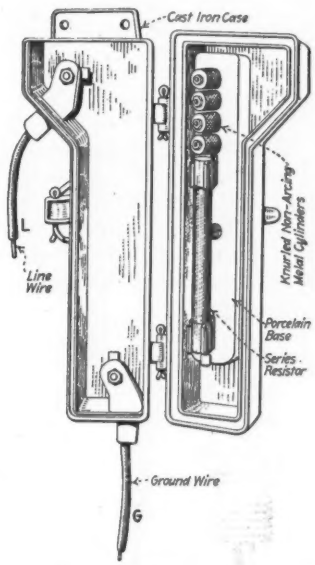


FIG. 11. MULTIGAP A.C. PROTECTOR WITH SERIES RESISTANCE ARRANGED FOR POLE MOUNTING

phenomena in a protector of this character. The metallic vapor conducts the current in one direction only. Therefore, when the current reverses, the metallic vapors tend to cool below the arcing temperature before the alternating-current wave is completed. Thereby the arc may be extinguished.

Protectors comprising non-arcing metal gaps with a resistance in series may be used for alternating-current circuits operating at pressures below 3000 v. A protector of this type (Fig. 11) comprises a sufficient number of spark gaps to prevent the passage of current at type are manufactured for voltages of from 1200 to 13,000. That shown in Fig. 13 is for 2200 v. There are three alternate paths through the protector of Fig. 13 for discharge. One path comprises all of the gaps, G_1 to G_{14}, in series. Another path comprises four gaps (G_1 to G_4) in series with a relatively low resistance, R_1. The other path comprises two gaps, G_1 and G_2, in series with a high resistance, R_2. Three paths to ground, each of a different impedance, are thus offered through the protector. Thereby a discharge of any frequency will find a path of a relatively low impedance for it to ground.

The path comprising the high resistance and the two series gaps is for discharges of low frequency or for discharging a gradual accumulation of static electricity. Discharges of medium frequencies will select the path comprising the low resistance and the four series gaps. Discharges of the high frequency will select the third path which includes only the gaps in series.

Why the lightning takes different paths may be explained thus:* When the gaps of a protector are shunted by a low-resistance, a discharge of the high frequencies find it relatively difficult to pass through the resistance rods. This is because of the impedance of the rods. However, such a discharge will follow with relative ease across all of the gaps because of the permittive (electro static capacity) effect of gaps. The series of gaps is, in effect, a number of permittors (condensers) in series. The higher the frequency the more pronounced is this effect. Hence, the discharges select the paths through the gaps and resistances which offer the least opposition. Which path is selected in any case will be determined by the frequency of the lightning discharge. By frequency is meant not the generator frequency but the equivalent lightning frequency which may be hundreds of thousands, or even millions, of cycles per second. If the power current tends to follow a lightning discharge it will, because of its relatively low frequency, select one of the paths through a resistance which will limit it. Due to the rectifying effect (described above) of the spark-gap cylinders, the arc should be extinguished at the end of the first one-half cycle after the generator current has started to flow. Figure 14 shows one of these protectors arranged in a wooden box for outdoor installation. G is the ground wire and L is the live wire.

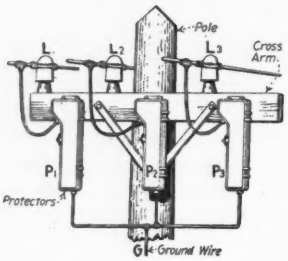


FIG. 12. MULTIGAP PROTECTORS MOUNTED ON A POLE LINE FOR TRANSFORMER PROTECTION

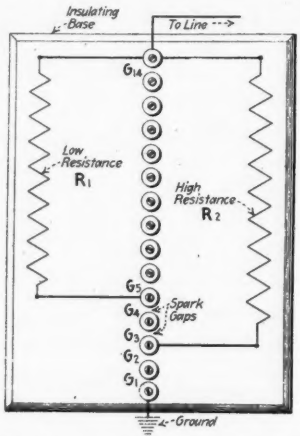


FIG. 13. DIAGRAM OF SO-CALLED MULTIPATH LIGHTNING PROTECTOR

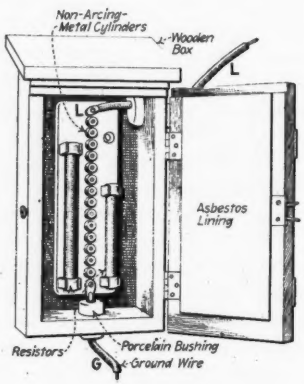


FIG. 14. MULTIPATH PROTECTOR IN WOODEN BOX FOR OUTDOOR SERVICE

A cupped-disc-gap protector is delineated in Figs. 15 and 16. This type of equipment may be designed for alternating-current pressures of from 3000 to 13,000 v. It comprises (Fig. 15) a series of cupped-shaped discs, D, of a non-arcing metal supported on an insulating rod, together with a resistance, R, in series. The line wire is connected to terminal, L, and the ground wire to G. This form was designed specially for distributing-transformer protection and in practice is arranged on the pole line as shown in Fig. 16 by suspending it from the line wire with a porcelain insulator. P_1, P_2 and P_3 are the protectors.

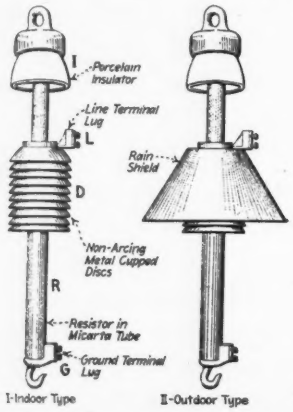


FIG. 15. WESTINGHOUSE CUPPED-DISC-GAP PROTECTOR

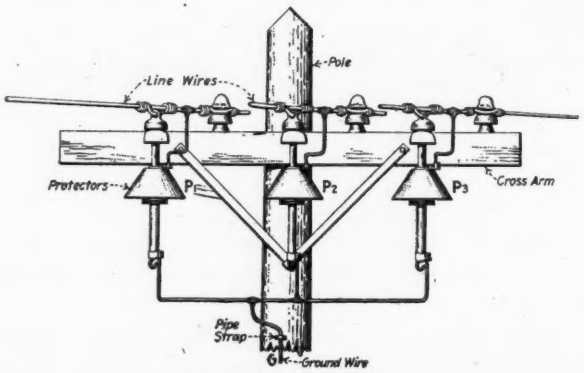


FIG. 16. OUTDOOR TYPE CUPPED-DISC-GAP PROTECTORS ON A THREE-PHASE LINE

Horn gap protectors are shown in Figs. 17 and 18. An electric arc once established, due to some cause or

*General Electric Co.

other, between two horns tends to extinguish itself. The arc rises on the horns, due to the upward flow of the column of hot gases, and finally attains a length of gap which it cannot maintain. Figure 17 shows a protector of this type for use on alternating-current series street lighting circuits where the normal pressure does not exceed 1500 v. L_1 and L_2 are the line wires and E is the ground connection. Protectors of this same general form are manufactured for alternating current pressures up to 9000 v. Abnormal voltage conditions, due to surges, are common on alternating-current-series lighting circuits. Such surges may be caused by the opening, short-circuiting or grounding of the circuits. These simple horn gap protectors appear, for this service, to provide effective protection. Electrolytic protectors, the principle of which will be described later, are preferable for the protection of direct-current series lighting circuits.

Figures 17A and 17B show recently developed types of horn-gap protectors arranged for suspending on line wires. In both of these illustrations L_1 is the line wire connection; L_2 leads to the apparatus (or choke coil if there is such) and G is the ground wire. A current-limiting resistor, R, is provided in the protector of Fig. 17B.

A combination choke-coil-and-horn-gap protector is shown in Fig. 18. These protectors are designed for alternating-current voltages of 33,000 and above. If an arc is established across the gap, G, it tends to rise and extinguish itself as above described; and, furthermore, the choke coil produces a magnetic field which, because of the phenomena described above in connection with a magnetic blowout protector, assists in the rapid quenching of the arc.

air and compresses it, thus extinguishing the arc. Protectors of this type are most frequently used on 2200-v.

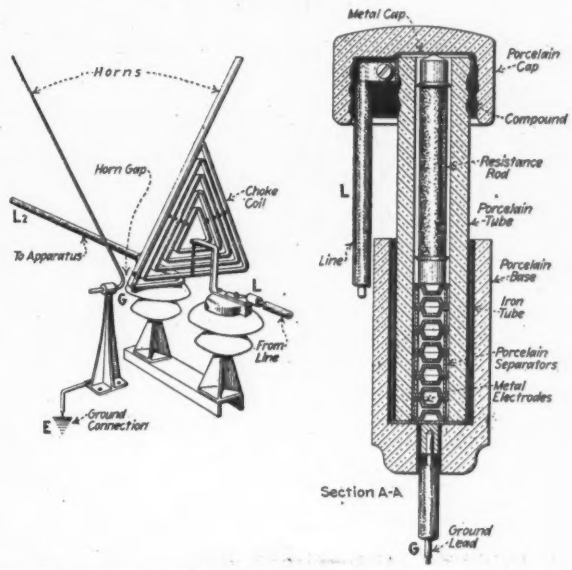


FIG. 18. HORN GAP CHOKE COIL PROTECTOR FOR A.C. LINES
FIG. 19. GENERAL ELECTRIC COMPRESSION TYPE LIGHTNING PROTECTOR

pole lines for distributing-transformer protection. They have a limited discharge capacity.

(To be continued.)

A THOUSAND cubic feet of natural gas has a heat value of one million heat units. A gallon of gasoline has

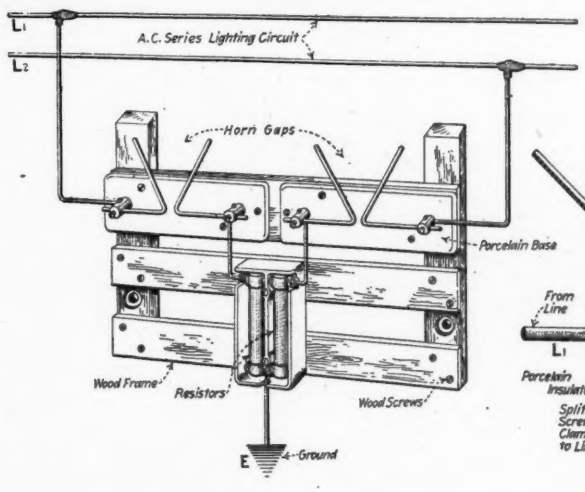


FIG. 17. HORN GAP PROTECTOR FOR A.C. SERIES LIGHTING CIRCUIT

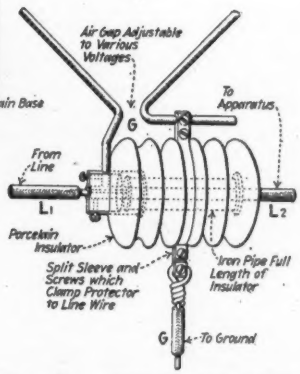


FIG. 17A. THE PIERCE LINE-WIRE, HORN GAP PROTECTOR (THE IRON PIPE ACTS AS A CHOKE COIL)

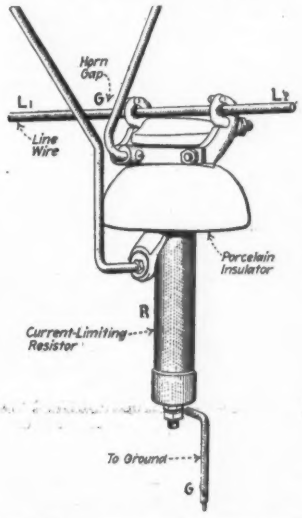


FIG. 17B. THE BURKE SUSPENSION TYPE LIGHTNING PROTECTOR

The compression-type protector (Fig. 19) comprises a number of gaps arranged in series with a resistor inside of a closed porcelain tube. An iron tube, which is grounded, surrounds the air gaps and equalizes the electro-static gradient. When a discharge passes between the metal electrodes which form the gaps, it expands the

a heat value of about 108,000 heat units. Therefore, a thousand cubic feet of natural gas has nearly ten times the heat value of a gallon of gasoline. With natural gas at 30c per thousand the heat given off costs the consumer at the rate of slightly over 3c per gallon of an equivalent in gasoline.

Testing Alternating-Current Generators

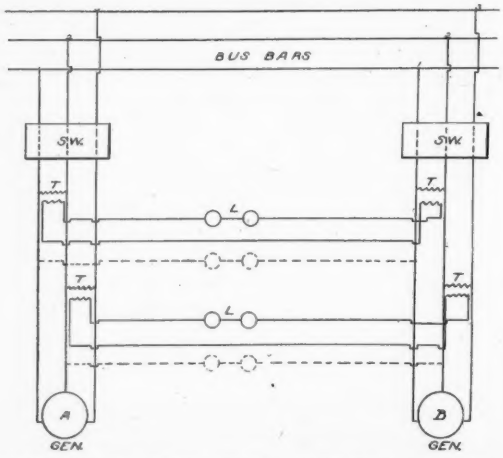
METHODS WHICH MAY BE EMPLOYED TO DETERMINE PHASE RELATIONS. BY R. L. MOSSMAN

WHEN installing an alternating-current generator to operate in parallel with others, it is necessary to test out the phases of the new machine before connecting it to the bus bars with the running machines.

Two methods for testing the phase relations of 3-phase alternators follow:

If a 3-phase motor is available, connect it to the bus bars, through a transformer, if necessary, and note the direction of rotation of the motor. Cut the running alternator off the switchboard and connect the new alternator to the bus bars, and note the direction of rotation of the motor. If the rotation of the motor is the same, the leads from the new machine have been properly connected for parallel operation. If the motor runs in the opposite direction, reverse any two leads of the alternator and try it out again.

If a 3-phase motor is not available, the machines will have to be tested out with lamps, as shown by the accompanying diagram. Connect the alternators to the bus bars through the main switch. If machine A is



CONNECTIONS FOR DETERMINING PHASE RELATIONS OF TWO THREE-PHASE ALTERNATORS

running, and B is to be tested for phase relation, leave B switch open. If the machines are low voltage, say 220 v., for example, connect two 220-v. lamps or four 110-v. lamps in series across two of the leads of the machines, as shown by the dotted lines. To check these connections, disconnect the leads from the idle machine, B, and close its main switch. Since both sets of lamps are connected through the switches to one machine, the lamps will be in the same condition as when both switches are open and both alternators are in phase. If both sets of lamps are dark, they will be the same when the phase relation is correct for paralleling the machines.

Open the switch from the idle machine. Connect the leads to this machine and bring it up to normal speed and voltage and note the two sets of lamps. If both sets are bright at the same time, and both dark at the same time, the phase relation of the machine is the same when the lamps are dark, and they can be paralleled at this time. If the pulsations of the lamps alternate, one set being dark when the other is bright, reverse any two leads of B machine and test out the lamps again, changing them, if necessary, so that they are the same when indicating synchronism.

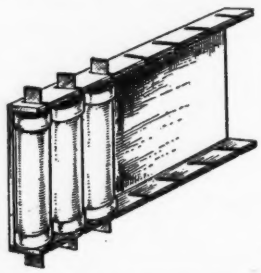
The lamps will now pulsate together, and the machines will have the same phase relation when the lamps are dark, or when they are in the same condition as they were when tested with the leads of the idle machine disconnected.

If the machines are high voltage, use transformers as shown at T-T-T-T and connections as shown by the full lines. After the machines have been tested out, one of the sets of lamps can be removed, as a set across one phase will be sufficient for paralleling after the first time.

The motor test will only show when the proper leads are connected to the bus bars. Lamps or a synchroscope must be used to indicate when the machines are in synchronism.

Low-Cost Fuse Rack

A RACK from which fuses can be taken quickly and which costs little or nothing to construct is in use at the Indian Orchard station of the United Electric Light Co. of Springfield, Mass. As shown, it consists of a pair of ¾-in. strips of wood with slots 2 in. apart and attached to a 13-in. by 8½-in. base, which is screwed to the wall at two points. The slotted pieces are 1¾-in. deep and accommodate seven 150-amp. in-



SLOTTED LEDGES THAT SERVE TO HOLD FUSES

closed-type fuses. No time is lost in hunting for fuses with this simple but effective arrangement.—Electrical World.

MORE MINERAL oils were exported from the United States during the fiscal year, 1917, than ever before, the total amounting to 2,749,438,434 gal., valued at $230,953,149, according to figures made public by the Bureau of Foreign and Domestic Commerce, of the Department of Commerce. This was an increase of approximately 300,000,000 gal. and $65,000,000 over 1916, and about 470,000,000 gal. and $79,000,000 over 1914, the last normal year before the war. Only a small percentage of the total exported was crude oil.

The war has had the effect of reducing the exports of illuminating oil, the foreign sales for 1917 totaling 835,114,403 gal. valued at $54,662,094, against 1,157,283,310 gal. valued at $74,500,162 in 1914.

WHAT COAL BUYER wants to swap horses, crossing the stream or not?—The Searchlight.

Performance of Raw Water Can Ice Plants*

Requirements for Clear Ice; Air Agitating Systems; Effects of Various Impurities. By Van R. H. Greene

ALL water contains air, and the presence of this air in the water during the freezing period breaks up the crystal formation of the ice in such a manner as to preclude the possibility of its freezing clear. This air can be expelled from the water either by boiling or by agitation, so as to drive the air particles to the surface. This latter principle is the one used in modern raw water can ice plants. The water in the freezing can is kept in continuous agitation by blowing air from an outside source into it, thereby maintaining a constant agitation. The agitated water washes the surfaces of the forming ice and drives to the surface the air particles, which otherwise would adhere to the ice. That this is true is proven by the fact that rubbing one's hand over the surface of partly frozen ice in the can enables one to judge by the degree of roughness whether the finished ice block will be clear or opaque. This means, then, in so far as the effect of air in suspension is concerned, that it is overcome by the present-day agitation processes, and it requires only an analysis of the water as to its mineral content to determine its suitability for manufacturing perfectly clear blocks of ice.

In order to keep the air passages always open, a pressure of 17 to 20 lb. per sq. in. must be exerted at the end of the air tubes to agitate the water continuously from the time the can is filled until the ice block is frozen solid. Therefore, in the modern high pressure raw water can systems theoretically it requires only a pressure of 20 lb. in the air laterals to produce the desired results.

High Pressure Air Systems

At the present time there are in use two standard high pressure air agitating systems. One has the air tube suspended from the short side of the ice can, hanging inclined, so as to protrude into the ice itself without coming in contact with the walls of the can. In the other method a small brass or copper tube is soldered along the side or corner of the can, down to the bottom. In both of these systems a pressure of approximately 30 lb. is kept in the air laterals to produce the necessary air agitation.

A certain amount of air is contained in all water, likewise there is a certain amount of water vapor suspended in air. When the air is cooled, this water vapor condenses in the shape of dew. The moisture thus precipitated tends to adhere to the sides of the drop pipe in the shape of ice, accumulating slowly but steadily until the air supply is shut off by the freezing up of the tube opening. To eliminate this entrained moisture the air must be subjected to a drying process, which usually includes compressing and cooling to such an extent that when the air is again expanded its dew point will be below that of the surrounding medium. This is much more difficult to accomplish where the pipe is in direct contact with the ice can, and therefore affected by the low temperature of the brine than it is when the air tube is surrounded only by the forming ice. In the first case the air must be cooled to at least 20 deg. F., while in the second case successful drying is accomplished by cooling to at most 40 deg. F. To avoid the possibility of condensed water freezing in the dehydrator, used with the suspended-tube system, the pressure is kept a little higher than is absolutely necessary for holding the air temperature at 40 deg. F., which is sufficiently above the freezing point to prevent trouble. In case it is desired to operate with a pressure of only 20 lb. per sq. in., effective drying can be produced by lowering the air temperature to 20 deg. F. with no more risk or trouble than in the fixed-tube system, where a temperature of 20 deg. is necessary to make this system operative under a pressure of 30 lb.

Much has been written on the chemistry of raw water ice, and great are the differences of opinion on this subject still, but unfortunately it cannot be made the essence of this paper. I shall, however, add some useful observations pertaining to this subject from personal experience in the field.

Quality of Water Important

The average city water contains little mineral matter in suspension, except at such times as the spring freshets cause the water to become turbulent. Thus, an adequate filter may not be necessary during the major part of the year; still there are times when heavy drains are made upon it, and for this reason it should be sufficiently large to withstand this abuse and at the same time not become inoperative by clogging up. It is safe to say that water containing mineral matter in suspension in excess of two grain per gallon will not make clear ice without the installation of the necessary filtration system.

Another source of great trouble in raw water ice making is the organic matter which is always present. This is responsible in most cases for the yellow core seen in the product of some raw water ice plants. This yellow core becomes objectionable if the organic matter exceeds two grains per gallon. When present in smaller quantities, it should be removed by the addition of alum to the water in conjunction with the filtration system. If the organic matter is much in excess of two grains per gallon, then clear ice can be made only by the removal of the core prior to the ice block being frozen solid. Oxide of iron present in quantities exceeding 0.05 gr. per gal. will produce a similar discoloring deposit, and therefore requires treatment for its removal.

Calcium carbonate, in almost any quantity, will produce a lime deposit in the core of the ice block, and to prevent this it should be removed by a lime apparatus constructed for this purpose. It is generally safe to say that waters containing more than four grains of calcium carbonate per gallon should be treated for the removal of this lime, regardless of whether it is the intention of the operator to remove the core or not, as in practice

*From a paper read before the American Society of Refrigerating Engineers.

it seems to be difficult to effect the complete removal of this substance by core sucking alone.

Air Supply

Different kinds of water require different rates of agitation. With average water containing up to 15 gr. of total solids per gallon, from 0.2 to 0.25 cu. ft. of free air per minute should produce the necessary agitation to effect the freezing of a clear 300-lb. block of ice; with waters containing solids in excess of this amount the agitation should be materially increased.

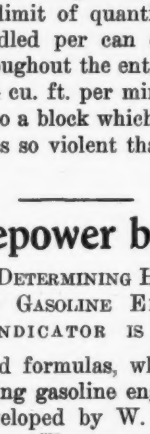
In one plant, clear ice was frozen with only about one cubic foot of free air entering the ice can during the early stages of freezing, and this quantity was gradually reduced until the ice block was frozen. Of course, a plant of this character is far too complicated to be called a commercial success, but the object of the experiments was to find out under what conditions marketable ice could be made from the particular water in question.

Practically, the limit of quantity of air which can be successfully handled per can on a standard high-pressure system throughout the entire period of freezing is approximately 0.4 cu. ft. per min. If more than this amount is supplied to a block which is two-thirds frozen, the agitation becomes so violent that finally no water is left in the core.

Brake Horsepower but no Brake

Formulas for Determining Horsepower and Efficiency of Gasoline Engines When Brake or Indicator is Not Possible

THIS method and formulas, which give a brakeless method of testing gasoline engines of hit-and-miss type, were developed by W. F. Schaphorst, and appeared in Iron Age. They are rationally based, first, on the fact pointed out by the late Dr. Thurston that friction horsepower is practically constant regardless of load; second, on the fact that when an engine comes to a dead stop after closing the needle valve of the carburetor, the rate of slowing down, or deceleration, is constant.



SECTION OF FLYWHEEL SHOWING A, D AND CENTER OF GRAVITY

No brake or indicator is needed, though the method does not supplant the indicator, which is still the best means for investigating the action in the cylinder as regards compression, ignition, exhaust and expansion.

First find the cross-sectional area A of the rim of the flywheel in square inches and its center of gravity. If the rim is of irregular section as shown in the cut, the area is found by making a drawing on stiff cardboard to scale and using the planimeter. Then cut out the figure and balance it in several positions on a knife edge, marking the knife-edge position in each case. The point of intersection of the lines will be the center of gravity.

Count the explosions while the engine is running loaded at normal r.p.m., N. Then take off load and count the explosions with the engine running idle at normal speed. Call these values E_l and E_i, respectively.

Shut off power by closing the needle valve with no load on the engine and note the number of seconds, t, required for the engine to come to rest.

Measure the outside diameter of the flywheel and from this and the distance of center of gravity from outside of rim, determine distance D in feet from center of gravity on one side to the like point on the other side.

To get the friction horsepower, Fhp., use the formula: F.hp. $= 0.000,001,52\ AD^3\ N^2\ n \div t$. Where symbols are as indicated and n is the number of flywheels, usually 1 or 2.

To get mechanical efficiency, M.Eff.:

$$\text{M.Eff.} = (E_l - E_i) \div E_l$$

Indicated Horsepower:

$$\text{I.hp.} = \text{F.hp.} \div (1 - \text{M.Eff.}).$$

Brake horsepower:

$$\text{B.hp.} = \text{I.hp.} - \text{F.hp.}$$

As an example, suppose that values are found as follows: $A = 16$ sq. in.; $E_l = 105$; $E_i = 16$; $N = 240$; $t = 60$ sec.; $D = 4$ ft.; $n = 2$.

Then $\text{F.hp.} = 0.000,001,52 \times 16 \times 4^3 \times 240^2 \times 2 \div 60 = 3$.

$\text{M.Eff.} = (105 - 16) \div 105 = 0.85$.

$\text{I.hp.} = 3 \div (1 - 0.85) = 20$.

$\text{B.hp.} = 20 - 3 = 17$.

Actual tests comparing this method with results from the indicator and Prony brake showed that the differences were so slight as to be negligible.

Increase in freight service demanded of the railroads of the United States this year is alone more than the combined traffic for a year of Great Britain, France, Austria, Russia and Germany. And this has to be handled with practically no increase of equipment over that of last year. Loading to 10 per cent excess of capacity by shippers is one thing that is helping to solve the problem. Another is quick loading and unloading of cars; still another, avoidance of hauling empties on a return trip.

Spite of all efforts, however, the problem becomes increasingly difficult as more and more supplies for the armies at the front and in training have to be moved. It is important, therefore, that power plants buy their fuel from the nearest source of supply to avoid long hauls; that consignees pool their orders so that shipment may be in carload lots; that waste be eliminated, not only to save material, but to save transportation; that passenger train service be reduced to that essential to the needs of the public; and that demand for, as well as manufacture of, goods not essential for healthy living cease.

Supply Wastes

Application of a Little Good Judgment and Carefulness Will Result in Large Savings. By H. A. Jahnke

A COMMON state of affairs found in the majority of power plants is the great waste of supplies which, if curbed, would go a great way in reducing general operating expenses. This may, to a marked extent, be due to the fact that these supplies are allowed to lie around and become ruined or the waste may even be deliberately caused by a careless employe.

In some plants it appears customary to purchase oil in wooden barrels, allowing it to remain therein until used. This is a source of much waste, as I have seen instances where, after some of the oil had been removed, a careless man forgot to close the cock and allowed the remaining oil to run out before the trouble was noticed. I have also seen much oil kept in wooden barrels lost due to the heat of the engine room drying up the barrel, causing it to leak. A particular instance of this kind was, where out of a 52-gal. barrel, 30 gal. of high-priced cylinder oil were wasted because the bands had fallen off and the barrel had been allowed to fall to pieces. It is better and cheaper in the long run where oil is bought in barrel lots to store it in metal tanks made for the purpose. Less oil is wasted in filling the oil cans and all possibility of loss due to leakage is removed. When impossible to obtain metal storage tanks, metal barrels should be insisted upon.

Waste of Packing

Much sheet and rod packing is wasted due to carelessness or poor judgment when cutting gaskets, etc. I have seen men lay out and cut gaskets from near the center of a new sheet instead of keeping close to the edge and thereby saving much material otherwise thrown away. Figures 1 and 2 show the proper and improper way of laying out and cutting gaskets.

Another way considerable saving may be introduced is by utilizing the centers taken from large gaskets for small ones.

I have found it good practice when much sheet packing is used to throw all cuttings of like thickness into individual boxes so that next time a gasket is required, the proper size and thickness of material is readily available.

Progressive engineers are always in the market for packing that will give better and longer service than that which they may be using. This is good practice, but many times a new packing is bought while there is still a large amount of the old on hand with the result that the old is not used and eventually thrown away. And while it may be better to use all of the old packing before making a change, there are times it may be more profitable to make such change regardless of the amount of old in stock, as the saving due to the elimination of expense connected with unnecessarily frequent renewals may more than offset the loss incurred by the throwing away of the old packing.

At times, much packing is wasted when rod rings are cut by an inexperienced man. They may be too long or too short or not cut as they should be to get the best results, when in order to remedy the trouble the packing must in a short time be removed from the stuffing box, thrown away and the box replaced. Where coil and spiral packing is used there is much waste due to short ends. I have made it a practice to buy all packing in ring form as I have found it pays in the long run and besides there is a better fit when the rings are cut by the manufacturer, the exact diameter of rod and size of stuffing box being given. Cut rings are applied more readily than the coil or spiral, although the latter has the advantage of being obtainable on short notice from any dealer.

Stock Records

In some plants it is the practice to allow new pipe fittings, etc., to lie around the plant or to be thrown into a box or barrel. Should a fitting be required on a repair job, it takes some time to find the right size or kind when the repair is delayed until the fitting is found or a new one bought. Should a new job come up it is not known what fittings are on hand that could be used. I have seen instances where fittings were needed on repair or new work where it was thought none of the required size were in stock, so that new ones were ordered. Later, they were found in some dark corner of the plant. In this way, many fittings are lost or damaged so badly they cannot be used.

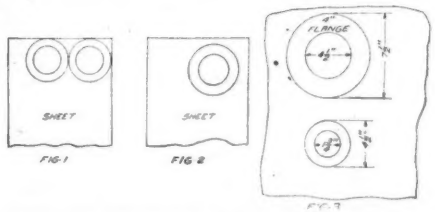


FIG. 1. CUTTING GASKETS FROM AS NEAR EDGE OF SHEET AS POSSIBLE WILL SAVE CONSIDERABLE MATERIAL

FIG. 2. WASTEFUL METHOD OF CUTTING GASKET FROM SHEET

FIG. 3. THE CENTER OF A 7½ BY 4½-IN. GASKET WILL READILY PROVIDE A 4½ BY 1¾-IN. GASKET

Have a list of all fittings with their size, type and quantity on hand and in this way know at a glance when repair or new work comes up if the proper ones are in stock or not. This saves much time, worry, work, delay, and expense.

As affecting the condition of the market with respect to lubricating oils and gasoline, the report for November from the United States Geological Survey on the petroleum situation is of interest. During the year 1916, the stock of oils on hand decreased from 187,965,000 bbl. in January to 174,028,000 bbl. in December, and in 1917, the decrease has been to 164,249,000 bbl. in September. This is a decrease of 2 per cent of the reserve during the first nine months of 1916, and 6 per cent of the reserve during the first nine months of 1917. The consumption increased during 1916 from 21,115,500 bbl. in January to 29,692,600 bbl. in December, and further increased to 31,657,000 bbl. in September, 1917. It is evident, therefore, that the consumption is running ahead of the provision with increasing rapidity, and this is likely to cause a rise in the cost of lubricating oils and a shortage in supply of gasoline in the near future.

Coal Pile Secrets

What the Fireman Found When Off Duty About the Origin and Variation of Coals

DEEP, steaming, gloomy forests, filled with rank undergrowth rising from oozy swamps and shedding yearly tons of leaves, fronds and spores,—and this process repeated for centuries,—were the origin from which came that coal pile which I am now using. Beds of peat, scores of feet deep,—and then strata of earth above, piling higher and heavier during thousands of years until the mass of peat was compressed from feet to inches, with gases held within the dense mass of hydrocarbons. And thus came the coal, by the slow workings of natural forces over thousands of years which we fling forth in a day from its hiding place, and destroy in an hour in our furnaces.

But why wasn't all coal formed alike? I wondered, and went farther for the answer. A thin section of coal under the microscope tells the story of whether cone-bearing trees, mosses, ferns or "horse tails," or a combination of all three furnished the vegetable mass which was the storehouse of energy. And as to the result in lignite, bituminous or anthracite, that came from varying conditions of weight and kind of the earthy mass above which gave more or less pressure, and allowed more or less of the gases to escape.

Stir the bottom of a pool where dead leaves lie thick, and the bubbles of marsh gas will rise. Here is an embryo peat bed going to decay and waste because no overlying earth prevents the escape of the valuable hydrocarbon gases and the contact of oxygen from the air and water. Protect this mass by tons of overlying earth and stone, and in aeons of time the coal vein will be formed.

Just what chemical action goes on nobody knows, but from the strata above and below the coal vein it is known that certain conditions have produced one kind of coal and other conditions another kind; with the coal veins are mixed layers of shale, sandstone, limestone and fire clay, and it is these substances that make the clinker and ash, and which show in the coal pile as rock and "slate."

Coal has as its foundation carbon, gathered from the air by the growing trees or plants and formed into vegetable cells. This it is which remains after the hydrocarbon gases from the chemical action of coal forming have been driven off by heat, leaving the pure carbon or coke mixed with earthy matter. But these hydrocarbon gases, which so easily fly away, carry a most valuable part of the heat content of the coal, and unless we take good care that they do not escape us, much of the value of the high volatile coals is lost.

Coal forming is not a human industry. The process is too long and requires too gigantic forces; but from the masses of material in various stages which are found in the crust of Mother Earth we can trace the changes and get to understand the method.

Leaves, fallen and rusty, pack together with the rains of autumn and the snow of winter and by spring the center of the mass is dirty and blackish with the first traces of the carbon of coal formation. Likewise dead bark, buried in the forest mold, soon begins the endless change. The harder portions of trunk and limbs resist the action of pressure and cannot be forced together to the density required for coal formation, nor will they retain the moisture necessary for the chemical action of coal forming. But distillation of the water and the gases leaves us the pure carbon in the form of charcoal, which is as near as human activity gets to making coal.

Peat beds give the next step in the process. Darwin found, in Tierra del Fuego and the Chono Archipelago, where mosses and ferns abound, peat beds in all stages of formation, from the fresh leaves near the surface to a confused mass at the bottom with no discernible form, saturated with water and compressed by the weight above.

Peat beds 12 ft. and more thick are found in numerous locations where the climate permits of slow decomposition at moderate temperature and with ample moisture. In the lower parts, the peat may become dry and hard, closely resembling lignite.

Brown coal or lignite is the next stage—a long way from the fresh green leaves, but also a long way from the perfected coal. From the beginning the gas constituents have become less either by escaping or by combining with the solid body of the mass, and the carbon has become an increasingly large part of the whole. In lignite the carbon is some 50 per cent, and if, as is frequent, considerable sulphur is present the fuel is useless for domestic purposes, although it may be available for some industrial processes, particularly in gas producers. In the United States lignite is little used because other forms of fuel are in most localities more convenient, but the beds of Nevada, Oregon and Wyoming are a storehouse which for future generations will be found of great importance.

From the lignite the process goes on by leaching out of earthy matter and further escape and combination of gases to Cannel which has 84 per cent carbon, Bituminous with 88 per cent, and shading through Semi-Bituminous to Anthracite with 93 per cent carbon. Cannel, because it is hard, does not soil the hands and can be handled in large masses is valued for grate fires and commands a high price, hence is not used in industry; but the bituminous, which readily parts with its gases, becomes our source of gas, benzol, tar, and coke, our only troubles being that the gases escape to a considerable degree if the coal is left exposed to the air, and it is difficult to burn them as fast as they are given off when the coal is exposed to the high heat of the furnace.

Semi-bituminous coals are especially valuable for steam making, as they burn rapidly and with little smoke, hence the name steam coal is often applied. Welsh coals and the West Virginia veins are of this variety and the "Pocahontas smokeless" is in this class.

By the action of great heat from the interior of the earth, as shown by the fused basalt that is often found in the seams, the gases were driven off from bituminous coals and these became the anthracites, so much valued for house heating because of absence of gas, smoke and dust. If carried even further, the heating process produced graphite, which is so hard and compact that it will burn only in an atmosphere of pure oxygen or at extremely high temperatures.

LETTERS DIRECT FROM THE PLANT

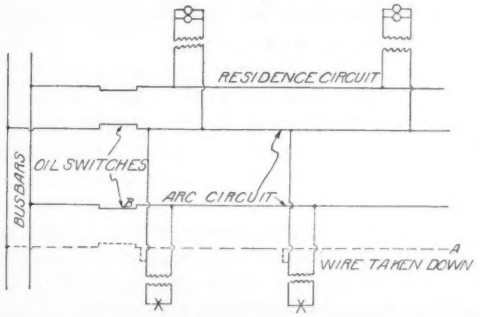
Cash Paid For Ideas Accepted. Sketches Desirable.
We Make The Drawings

Meeting a Shortage of Copper Wire

DUE TO the inability to obtain a sufficient amount of copper wire required for extensions which we desired to make to some of our primary lines, we had practically given up our plans for the time being.

There was, however, a two-mile, single-phase circuit made up of number 4, running from the power house to a north-end addition of the town which was used for residence lighting. Carried on the same pole line was a multiple arc street lighting circuit supplying current to individual arc lamp transformers in the same district. These lines were of number 6 copper wire.

Realizing that the residence lighting load was not sufficient at any time to overload the circuit conductors, I decided not only to simplify the arrangement of equipment and its operation, but also to reduce the amount of copper employed. This I did by means of the scheme



SHOWING MEANS BY WHICH ONE SIDE OF ARC CIRCUIT WAS ELIMINATED

indicated in the accompanying illustration, using one side of the residence circuit primary as a common return conductor for both circuits and thereby releasing one entire side of the arc circuit for other work. I found this just sufficient in length to make the desired extension. And as may be noted, the arc circuit which is run on a moonlight schedule can be cut into and out of service by means of oil switch B, without in any way affecting the satisfactory operation of the residence lighting circuit.

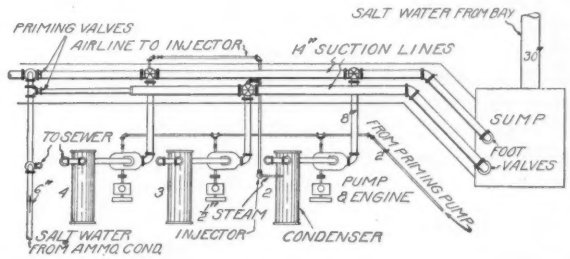
I was thus enabled to make the necessary improvements to our lighting system without any expenditures whatever for wires. F. E. BACON.

Priming Connection for Centrifugal Pumps

WHY IS IT we often keep on putting off the installation in the plant, of some of the numerous little wrinkles and conveniences which would so greatly lighten our daily tasks, and help us out of tight places, that we wonder after they are installed, how we ever got along without them?

I suppose the answer would be, in most cases, that the work around the plant must be planned and executed in the order of its importance. At least, such was the case in a fairly large central station in the tropics with which the writer was lately connected. It was finally found, however, that it paid in the long run to allow some of the seemingly important things to slide a little, or else put in some overtime, in order to install some conveniences, so that more uninterrupted attention could be given to the larger matters. In this connection, I believe it is true that we are all apt to be mistaken at times in our judgment of the relative importance of the different items of work with which we are confronted.

In the plant mentioned, there were three turbo-generating units, each with its own condenser equipment. The centrifugal pumps furnishing circulating salt water for the condensers were connected to the two 14-in. suction lines, as shown in the sketch. Each of these lines



PUMP PIPING SHOWING SPECIAL PRIMING ARRANGEMENT

was equipped with a foot valve in the salt water sump, and the original method of priming was to fill these lines with the salt water overflowing from the ammonia condenser. This scheme worked out nicely, sometimes, when the foot valves would seat tight enough to allow the rather copious supply from the ammonia condenser overflow line to fill the suction lines and pumps. At other times, it was a mad scramble with much heart-breaking manipulation of valves and priming water, both to the pump and suction line, to get the pump primed.

On one such occasion, while in charge of the evening watch, I knew it would be necessary for me to change from No. 3 unit to No. 4 before I turned over to the relief, as the vacuum was slowly dropping off on the former, due to the dirty condensing water stopping up the condenser tubes. Accordingly, I started in about 7:00 p.m. to get the pump for No. 4 primed. About 3 hr. later, after I had about exhausted my resources and also my vocabulary, the blamed pump took hold and went to work as it should. Right then I made a resolution that never again would I repeat that performance, and my faith in foot valves was destroyed forever.

I found an old boiler feed injector and discarded all the parts except the steam nozzle and suction connection. With the help of one of the natives, the holes in the two angle gate valves were drilled and tapped and the air and steam piping to the injector installed as shown. The whole scheme worked like a charm. It was only necessary, say in starting No. 4, to have the pump at rest and its suction valve closed (also the valve at No. 2 if it did not happen to be running), then fill the pump or pumps and condenser with water from the priming connection at bottom of pump in order to seal the angle gate valve, and start the injector. When the injector started to throw solid water (in this case, about 4 min.) the pump was started and its suction valve opened at the same time, and when a solid stream of water was coming from the condenser overflow the ejector was shut down and the priming water cut off.

For the benefit of anyone who was skeptical about the performance of this method, and to avoid any further trouble with a deranged or stopped-up foot valve, the foot valve was removed entirely on No. 2-No. 4 suction line, which silenced any further question on that score. It was then pointed out that the standard method of priming a centrifugal pump was to make the air connection at the top of the pump where a plug is usually provided. This is very true and would apply to most cases. In this case, however, we had no means of closing off the discharge of the pump or the overflow from the condenser during the priming operation, and it would have been expensive and meant a great delay to requisition a suitable check or clapper valve for the overflow lines.

If a priming scheme like this had been employed when the plant was first installed, many an hour's hard work would have been saved, and also the cost of the two 14-in. foot valves and the heavy piping and valves which were installed to utilize the ammonia condenser water for priming.

It will also be observed that if No. 2 and No. 4 were running at the same time, one pump would rob the water from the other and both would lose their suction if any dirt or accumulation of any kind should restrict the opening at the strainer of the foot valve, and this event did occur a number of times. W. J. S.

More Power with Two Eccentrics

A SLIGHT CONTROVERSY is taking place, I notice, regarding the action of two eccentrics on Corliss engines. One engineer maintains that more power can be developed with two eccentrics, while the other thinks otherwise. The first mentioned (J. C. Hawkins) cites a rolling mill engine, and I, from personal experience, affirm that he could not have picked a better example.

My own experience has carried me into the rolling mill and electric railroad service, and in both of these it has been my fortune to see just what the difference between a single eccentric and a double eccentric outfit was.

In the first-mentioned place, we operated a pair of single eccentric cross-compound Corliss engines in one engine room and as we were the farthest from the billet mill our stock had more of a chance to cool and consequently our engines had to pull mighty hard at times.

A representative of the engine company was called in and stated that it would be no new idea to equip the engines with double eccentrics and give them considerably more power. Our chief sprung the old saw—"You can't get any longer cutoff than 7/8 and we are getting that now!"

The factory man came right back with this remark: "You don't have to get more than 7/8 cutoff to get more work out of them. I will give you more work with 3/4 cutoff than you are getting now with 7/8!"

These statements startled me, but then a lot of the rolling mill stuff had got in my system and I was good for one more round.

"Well, Mr. Dash," said the chief, "if you can explain just how 3/4 cutoff will do more work than 7/8, I guess you will land the job."

"Chief, if you maintain 3/4 cutoff for 20 strokes, won't it give you more power than a 7/8 cutoff for three strokes, 1/4 cutoff for two, a 3/8 for two more, than a scant half for one or two and then 1/8 again?"

"I never thought of it in just that light, but it does sound good," the chief admitted.

That is the secret of why the double eccentric gives more power.

It does not give more power than the single eccentric for one or two strokes, but it gives more power for several strokes. With the single eccentric engine, 7/8 cutoff may mean overspeed; then when the governor rises to a higher plane, the cutoff is immediately cut to scant half, which is underspeed.

We were able to roll several tons more stock in 24 hr. with two eccentrics than we could possibly roll with the single eccentric equipment. And as more production meant more power, I just tipped my bonnet to the wise head that evolved the scheme and said, "Verily, I have been shown."

The same held in the railway plant. Two engines were exactly alike, minus one eccentric. One engine had two eccentrics, the other had one. We always operated the single eccentric on the lazy shift, and the double eccentric on the peak. The breakers would blow three times as often with the single eccentric as with the double. If the speed was kept constant, the voltage remained high and perhaps 1200-1400 amp. would run smoothly; but if the speed lagged, the voltage dropped and then the amperes ran up to 1500 and the breakers let loose.

The chief in this station claimed that with late cutoff on the single eccentric engine, the release was retarded and a back pressure accumulated, whereas the release on the two-eccentric was quicker and several horsepower gained thus.

Candidly, I believe that both Mr. Hawkins and Mr. Wakeman understand the Corliss engine fully as well as

TOM THUMB.

Broken Gland Flange

IT APPEARS TO ME that "Dad," the engineer of the old school, whose two pointers Jack L. Ball passed along, on page 900 of the Nov. 15 issue, is given somewhat to exaggeration for a man who professed to be one of the boys for years. It's kind of hard to swallow that stuff about the sign, especially when "Dad" tells how the

engineer came to him and solicited help for such a minor breakdown to a stuffing box gland.

Anyone professing to be an engineer, who will admit being up against it under such conditions, seems to me to be the last one on earth to put up such a sign. There are half a dozen ways that a broken gland such as mentioned could be made serviceable again without waiting a week to get a new one. In fact, I am of the opinion that "Dad" went to considerable trouble to make such a repair.

Accompanying Figs. 1, 2 and 3 show how the writer has dealt with the same sort of trouble, making the repair in half an hour. A piece of 1/8-in. sheet steel was obtained, and a cardboard templet made from the gland flange; two pieces were then marked out as in

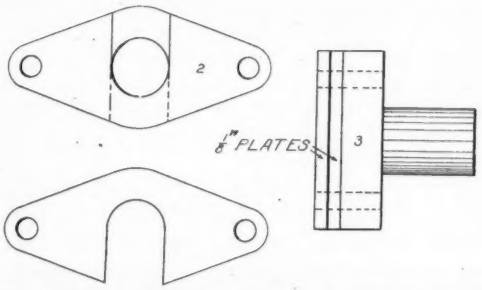


FIG. 1. FORM OF SHEET STEEL PLATES CUT TO FIT GLAND FLANGE
FIG. 2. PLATES READY TO MOUNT
FIG. 3. PLATES IN POSITION AGAINST FLANGE

Fig. 1 on the sheet, and with a hammer and chisel they were quickly cut and finished in a vise, with a rough bastard file, making the rod and stud holes easy fits. These two pieces were slipped in place without taking out the rod, as shown in Figs. 2 and 3.

The writer has found that where advice and suggestions are not wanted, the sign reads: No visitors allowed in the engine room. C. H. WILLEY.

Handholes in Centrifugal Pump Suction

IN REGARD to criticism of my article on Handholes in Centrifugal Pump Suction, published in Oct. 15 issue, I wish to say that I am perfectly familiar with this type of pump, and that we have six single-stage centrifugal water pumps in our plant, and there is not a strainer on the end of any of the suction lines.

Of course, some will say this is all wrong, but I cannot agree, and would say that it is neither customary nor practical to put strainers on the end of suction pipes of any great size, especially where the suction pipe is vertical.

Twin strainers are sometimes used on horizontal lines and are a good thing in certain cases; however, the more practical way is to take water from an intake channel provided with screens at the mouth of intake, which can be removed and cleaned, and I would say that this is exactly what we have in our plant; but there are times when a certain amount will get by, even with the utmost care.

As to proper installation, this pump was installed by one of the largest condenser and engineering companies in existence today, which thoroughly understood our conditions.

The suction pipe on this pump is 24 in. in diameter and 18 ft. in length. It is connected to the bottom of the pump and extends straight down through a concrete floor into the intake channel.

At the time the pump was installed a certain amount of foreign matter, such as blocks of wood, etc., got into the intake channel and this was picked up by the pump when it was put into operation.

I fail to understand just how anybody could get at the strainer on the end of this suction pipe to clean it when it became clogged up, especially when it is 8 or 10 ft. under water. And it would be next to an impossibility to disconnect it from the pump and raise it; even if that were possible it would cause the shutting down of a 6250-kw. machine while it was being done.

As for pumps seldom being made with handholes, there are well-known pump builders who make all their double suction pumps with either split casing or handholes in the casing or suction lines; and I still maintain that this is the right way.

It may be that a dredging pump would make a good circulating pump for a condenser of this size, but I hardly think it would pay to make the change at present.

The fact is that the nozzles were plugged up; so it was simply a case of where they had to be cleaned somehow, and the article states the means employed.

E. C. WELLS.

Engine Troubles

THE HEAD-END dashpot of a Corliss engine started to give trouble one morning by not seating properly; no adjusting of the air regulating valve would remedy the trouble. As the engine commenced to pound badly, we were about to shut down, but received orders to keep going, if at all possible, until night. I then decided to make a temporary repair by attaching a spring to the

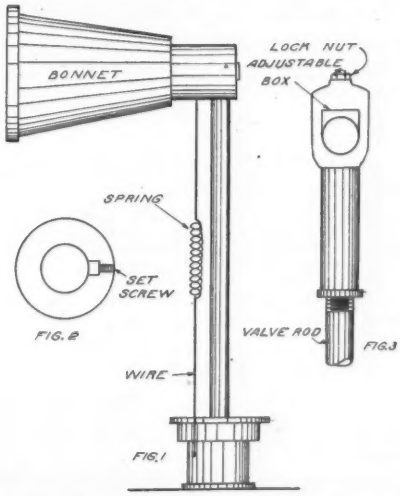


FIG. 1. METHOD OF ATTACHING SPRING TO CLOSE VALVE
FIG. 2. NUT USED TO HOLD DASHPOT PACKING IN PLACE
FIG. 3. ON SOME VALVE RODS, WEAR OF THE BOX BRINGS HEAD OF THE SET SCREW CLOSE TO THE LOCK NUT

dashpot, as shown in Fig. 1. This spring was placed while the engine was running. Its speed is 85 r.p.m. The spring was pulled just about tight enough to pull the dashpot down without striking hard at the bottom.

Of course, the steam valve was not closed as quickly as if the dashpot had been in working order, thereby causing some little waste of steam, although the engine was kept going.

When pulling the dashpot apart it was found that the nut holding the leather packing at the bottom had worked loose, and I was surprised that something did not break, as when the dashpot was withdrawn the nut and leather packing remained in the bottom of the pot. The type of nut used is shown in Fig. 2. I think the set screw became loose, in turn allowing the packing nut to loosen.

On Corliss engines where the rod heads on rods from the wristplate to the valve stems are equipped with an adjustable box for taking up wear, which is done by means of a set screw and lock nut passing through end of rod head, the box is at times worn badly so the lock nut is close to the head of set screw, as shown in Fig. 3. Where no adjusting can be done, due to the set screw being too short, at times it happens that there is no longer set screw of this size on hand. The writer has overcome trouble of this nature by sawing off part of the lock nut to make it thinner, thus allowing the set screw to turn into the rod head further to take up wear on the adjusting box. I have found this to be a better idea than placing shims between set screw and adjusting box which at times work out of place and cause more trouble.

H. A. JAHNKE.

Let's Be Fair

WHILE THE SUBJECT of war spirit may not belong properly in such a magazine as Power Plant Engineering, it faces us in such a manner that it may not be ignored. I am a constant reader of everything I can get hold of except the Nick Carter class of literature, and in every paper, book or magazine we seem, in general, to be acting like a lot of foolish children. We are in war against Germany—and it promises to be a fearful struggle, and one in which every American, be he descended, as am I, from German blood, or from Swedish, Spanish, English or any other, should throw all his energy.

If we are not called upon to carry the rifle then we should be glad to wield the hoe, the pick, shovel, hammer or any other tool which will help produce some needed thing, for everything produced is going to be of just that much assistance to those who man the ships or carry the flag against our enemies. But in so doing, let us try to remember that America itself is composed of men from all the world, and that the German, or the Austrian who is loyal to America is probably as good an American as is he who can boast of the original American Indian blood—than whom there can be no truer citizen.

This brings me directly to the things which look so foolish and so childish. In parts of the country, the German flag has been burned; in other places, the kaiser's picture has been torn from the wall. Again, we find some classes of newspapers printing editorials along such lines that a real American blushes for shame to think how peevish we can become. If this did aught more than to make those of German blood feel embarrassed, it might be well to do such things; but it does not help a particle toward winning the war. It produces nothing that might benefit either ourselves or our troops; and as for even annoying the kaiser, I venture to say that his mind is too much occupied to even take notice of these petty acts. We know there are no better hearted people than the German people, and while I, like thousands of others of German descent, deeply deplore the fact that we must lick Kaiser Bill, yet I am ready at any time to go across and do my best toward that very thing.

Those loyal Americans of German blood feel as I heard a German say a few days ago: "My friend, I've given gladly five sons; three are in the navy, one with the regular army and one with the guard; and I'd go myself if they would take me. All are loyal Americans, I am also loyal; though I've brothers in the German army and perhaps I would be the slayer of one of them, yet I'd do so gladly for America. And yet, because of my blood, I'm treated as a man without a country. The papers embarrass me. Some people of the city, who know I've given all my sons to the cause and who have given nothing themselves, more than criticism of the government's acts, scorn me."

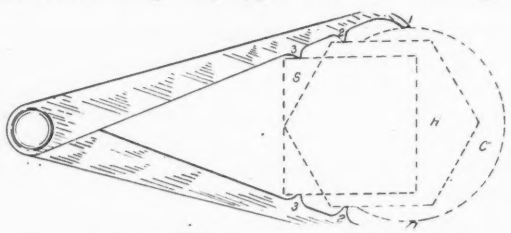
And, in traveling about some, I've found such things to be true; so I make this plea that, though the war must be bitterly fought out, we drop these childish ways and instead of embarrassing those of German descent, endeavor always to show them that they are really and truly appreciated and make them feel that they are not men without a country. Let us be men.

JOHN PIERCE.

Proportional Calipers

IN THE accompanying illustration is shown a caliper which may be of interest to the readers of Power Plant Engineering. This caliper will give the diameter of a round piece of stock required to make the largest possible hexagon, H, or the square, S.

The distance between points 1-1 is equal to the distance between diagonally opposite corners of hexagon H,



SHOWING HOW PROPORTIONAL CALIPERS MAY BE USED

or square S, points 2-2 and 3-3 being the distance across the flats of the hexagon, and square. The ratio used holds good up to the capacity of the caliper, and whether employed as shown, or as an inside caliper.

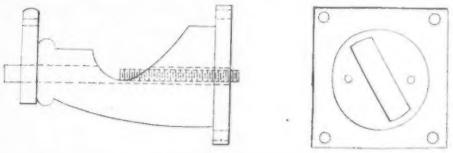
R. L. MOSSMAN.

Unusual Engine Accident

A PECULIAR accident happened on a 23 by 36-in. Corliss engine of the double eccentric type, which resulted in a broken rocker arm. To use longer packing gland studs than was possible in the usual manner, the holes had been tapped in the valve bonnets from the opposite side and full thread studs run through and cut off flush with the face of the bonnets.

This had been done either by the builders or in the course of repairs.

Repeated drawing up of packing nuts had evidently loosened one of the studs in the bonnet of the head end exhaust valve, as it was found to have backed out about 3/16 in. The fact that it was allowed to back that distance before being caught by the valve stem head, was likely due to end play of the stem, which had allowed it to pass the end of the stud, until a sudden end thrust allowed it to catch with the above-mentioned result.



STUD IN VALVE BONNET WHICH GAVE TROUBLE

Removal of the other exhaust valve bonnet disclosed the fact that the studs had been put in in the same manner; so they were all taken out and replaced with shorter ones with taper thread and put in from the gear side of the bonnets, before again putting the unit in service.

G. E.

Counting Revolutions Without a Counter*

A SPEED COUNTER is not an absolute necessity for determining the speed of a turbine, motor, spindle, shaft, or other rapidly rotating machine part. Speed can be counted "by hand" to a surprisingly high limit by using the fingers in connection with your nimble mind.

For instance, you can count up to 10 very quickly—much more quickly than you can count from 10 to 20. This is because it takes more time to allow the longer names to pass through your mind, such as 13, 14, 15, etc. They are all two-syllable words. The logical way to count rapidly, therefore, is to count up to 10 over and over and keep tab on the number of times counted to 10 on your fingers. It will surprise you how easy it is to count in that way. To count 400 or 500 r.p.m. in that manner is no trick at all. If one should try counting "straight," however, he will find it too cumbersome to say "twenty-one," "thirty-seven," etc., even mentally, and the job will have to be abandoned.

Just let some projecting piece from the shaft, pulley, or whatever it may be, strike a finger of one hand as it rotates, and with the fingers of the other hand keep tab on the number of tens. It isn't necessary to count a full minute, of course. If you count for 15 sec., multiply the result by four and the product is the r.p.m. If you count for 10 sec., multiply the result by six and the product, again, is the r.p.m.

Another simple way is to attach a long thread onto a lead pencil (Fig. 1). The pencil should have a rubber eraser at one end. Hold the eraser end against the end of the shaft in the same way that the regular speed counter is used, bearing against the point of the pencil with a piece of hard wood or metal to provide a pivot bearing, and the thread will wind upon the pencil as the pencil spins.

At the end of a half minute, or 5 sec., or thereabouts, remove the pencil and count the number of turns of thread upon the pencil. It is then a simple matter to compute the revolutions per minute. If you have had the pencil winding the thread for 6 sec. multiply the number of turns by 10 and the answer is the r.p.m.

If conditions are such that the machine or shaft can be stopped temporarily, a very simple way to count the revolutions is to run a lead pencil lengthwise of the shaft for a period of 5, 10, or more seconds, making a mark on the shaft during that period (Fig. 2). The mark made, of course, will take the form of a spiral, but all that is necessary is to count the number of turns made during the test period, and then compute the r.p.m., which is done as already explained.

This method is valueless if the shaft cannot be stopped. One point worthy of remembering, though, is that the mark will remain on a shaft for some time. At the end of the day's run, therefore, it would be possible to count the r.p.m. made during any period of the day. If the shaft is a long one it can be made to register the speed during any hour or every hour.

A very effective and simple method is to file a niche in the end of the shaft and run a piece of cardboard or

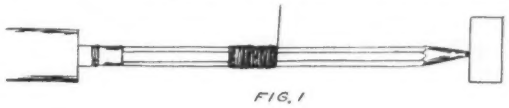


FIG. 1

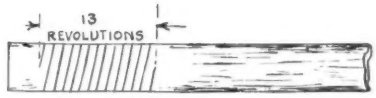


FIG. 2

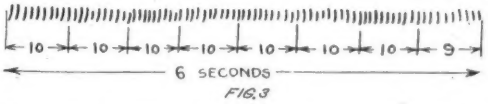


FIG. 3

FIG. 1. USING PENCIL AND THREAD TO DETERMINE SPEED
FIG. 2. MARKS ON SHAFT INDICATE SPEED
FIG. 3. MARKS MADE BY NICHE IN SHAFT

paper along against the edge (Fig. 3). A series of marks will be made on the paper as indicated in the sketch, and by timing the operation and counting the number of marks it is a simple matter again, just as above, to determine the speed of the shaft. Even if the speed is 3000 r.p.m. or more, it makes no difference in this method.

For example, this record shows 79 marks made on the paper in 6 sec. It will be noted that I have divided the record into groups of 10 marks to facilitate counting and to guard against error.

"Divide the number of seconds into 60 and multiply by the number of marks" is the rule that applies to this and all cases explained above.

$$60 \div 6 = 10$$
$$79 \times 10 = 790$$

Therefore, the shaft makes 790 r.p.m.

It is now clear that a special speed counter is not an absolute necessity. There are a great many ways in which problems can be overcome that appear difficult at first blush. A speed counter is handier, to be sure, and one should be owned if it is necessary to determine speeds often. But for special cases, any one of the above hand-made counters will do very well.

W. F. SCHAPHORST.

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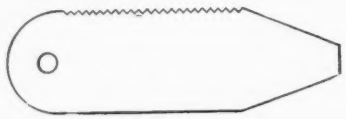
Successful Kinks From The Plant

For Saving Time, Work and Trouble

Handy Key Ring Tool

IN THE accompanying sketch is shown a midget screwdriver and marker which may be made from a broken hacksaw blade. The screwdriver is intended only for special work as, for instance, where necessary to insert or remove screws, say, in a condulet fixture with the fixture so close to the ceiling or wall that the ordinary screwdriver is too long to insert and use in the restricted space in which it is obliged to work.

On the back of telephone switchboards and in similar places it is frequently necessary to handle small screws where the space is so limited that the use of a tool over 2½ in. in length which cannot be inserted between the screwhead and the wall or backing immediately behind it is utterly out of the question.



SCREWDRIVER AND MARKER MADE OF HACKSAW BLADE

The tool shown, made from a broken power saw blade, is ¾ in. wide and 1/32 in. thick and is sufficiently strong and rigid for pretty stiff work. As a screwdriver it may be slipped off the key ring while being used; but as a marker for scratching conduit, pipe, iron bars, small shafting, etc., it is not necessary to remove it from the key ring.

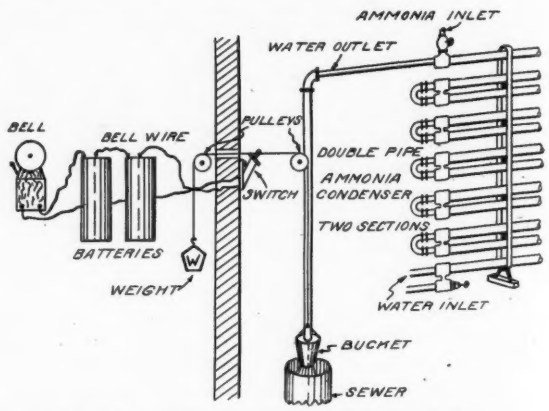
It leaves as a mark the imprint of the hacksaw blade, a clearly defined cut 1/32 in. wide which cannot be erased short of filing or grinding and unlike the electrician's pencil it is always where it can be found when it is needed.

T. H. REARDON.

Some Pump Difficulties

OURS IS NOT a large plant, and the engineer has other things to do besides watch his boiler and compressor. We have high and low water alarm, etc., but the water for our ammonia condensers is furnished by a double-acting steam pump of the cross arm type. Any variation of the steam pressure causes it to slow down and stop or else speed up and stick at one end of the stoker. You can imagine what happens to the pressure on the condensers if no one notices it for a few minutes.

I made the following apparatus, which works perfectly: A bucket with perforated bottom hangs under the condenser outlet. A window cord passes from this over a pulley through the wall over a pulley and is attached to a weight. A switch (single pole knife-blade type) is attached on the condenser side of the wall close to the hole which carries the cord, and the handle of the switch is fastened to the cord. An electric bell is located in the factory and can be heard in all parts. When the pump is throwing the proper amount of water, the bucket remains full and holds the switch open. Should the pump slow down or stop, the water in the bucket runs out through the holes in its bottom, and the weight closes the switch, thus ringing the bell. The success of the apparatus depends on one's getting the holes in the



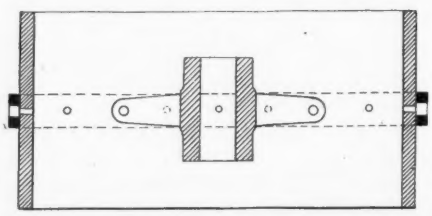
DEVICE FOR GIVING ALARM WHEN PUMP STOPS

bucket of such size that it will remain full of water when plenty is going over the condenser, but will empty automatically when the water supply is low.

JOHN A. PALMER.

Remedy for a Troublesome Belt Pulley

AN OLD belt driven coal crusher was installed in a large plant in which the writer came in frequent contact and they experienced considerable trouble with the belt pulley drive, represented by excessive slippage and throwing off of the belt. This difficulty was doubtless the result of the excessive overload imposed on the



PULLEY WITH A LEATHER RING RIVETED ON CROWN

machine when certain masses of coal were in the crushing jaws. Because of space conditions, it was impossible to use a wider belt or a larger diameter pulley. The presence of dust and grit also made the use of belt dressings or other preparations ineffective. The writer happened to be in the plant one day when the particular

drive was giving trouble and suggested that they employ a remedy he had seen used in several instances before where belts persisted in slipping or sliding off. As shown in the sketch, a band of belt leather about 1 in. wide (¼ in. thick) was riveted to the pulley face. After this change was made, it was found that the slipping off of the belt was averted entirely and the trouble from slippage was greatly minimized. M. A. SALLER.

Kinks for the Boiler Room

FIGURE 1 illustrates a tube pilot for guiding the ends of tubes through the flame plates of B. & W. boilers. The tapered mandrel expands the split male end inside the tube, thus insuring the pilot remaining in the tube while working it through the flame plates or baffles. It will

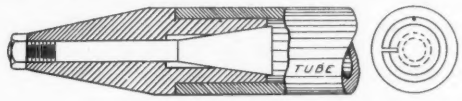


FIG. 1. TUBE PILOT

be found very useful when one or two tubes are required to be renewed in the center of a group.

Figure 2 shows a relief valve made from an old angle valve, by filing off the threads of the valve stem and using the principle of the lever safety valve, as shown.

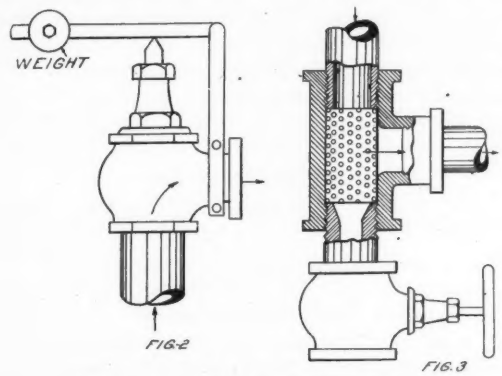


FIG. 2. HOME-MADE RELIEF VALVE
FIG. 3. SELF CLEANING STRAINER

Figure 3 shows a self cleaning strainer for oil fuel supply line, etc., made from regular pipe fittings.

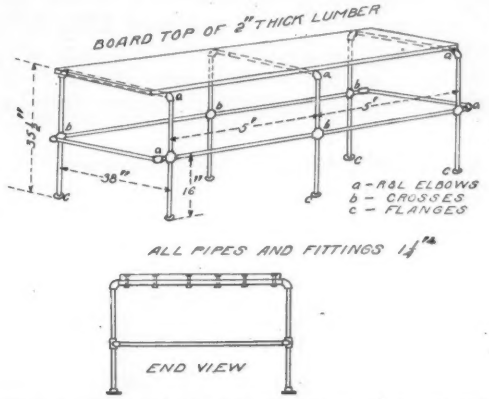
C. H. WILLEY.

Clearing Lubricator Glasses

HERE IS a novel way for engineers to prevent cylinder oil from sticking to the sight feed and gage glasses of their lubricators. Place a small piece of white soap (any kind will do) in the lubricator when filling it. Let it run dry the first time and that will wash the feed nozzle and sight feed glass. I used to put soap in the feed glass; but this made the drops of oil too small, so I put a piece of soap into the lubricator with the oil to see what the effect might be. The lubricator ran dry before I refilled it, and to my surprise the soap not only cleared the sight feed glass, but also the gage glass. That was 2 yr. ago and no oil has stuck to the glasses since then. The soap will not harm the engine cylinder or the valves in any way. WALTER E. ROBINSON.

An Easily Constructed Work Bench

SHOWN HEREWITH is a simple work bench which, except for the top, which is of wood, may be made of 1¼-in. piping and fittings of like size. This bench, being



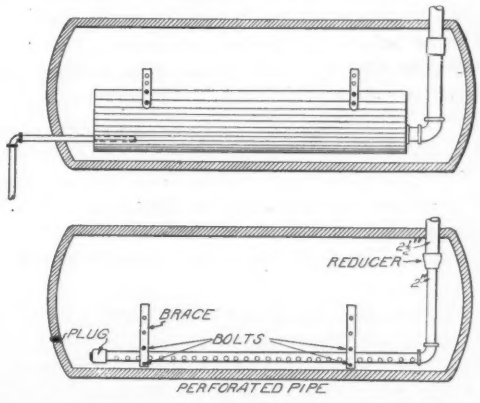
A LIGHT AND PORTABLE WORK BENCH MADE UP OF PIPE AND PIPE FITTINGS

comparatively light and portable, is particularly useful for pipe fitters, plumbers or electrical workers.

C. C. SPREEN.

Eliminating the Boiler Pound

IN THE accompanying sketches is shown the method we have employed relative to the introduction of feed to the rear drum of our three-drum type of water tube boilers. With the original arrangement, excessive pounding would occur immediately after blowing down; but since we have removed the sediment pan and replaced it by an extension pipe drilled with 9/16-in.



METHOD OF INTRODUCING FEED WITH AND WITHOUT USE OF THE SEDIMENT PAN

holes, as shown, the pounding has not only stopped but we have found no more sediment in the drum than before, more room for cleaning is available, and the graphite which we put into our feed water is no longer retained in this drum. C. A. DILLE.

MOISTURE IN coke can be determined quickly and with adequate accuracy by simply heating to a constant weight a large sample of lump coke, in any convenient oven, or on a stove, hot plate or steam coil at a temperature of 100 to 200 deg. C.—Bureau of Mines Bulletin.

Questions Answered and For Answer

Expert Help When In Trouble. If You Want Quick Answer Enclose a Stamp

Boiler and Engine Questions

WHY ARE the valves of a single eccentric Corliss engine given (a) lap and (b) lead?

2. Describe the construction and operation of an accumulator as used on a vertical turbine.

3. What is the highest speed at which a cast-iron flywheel may be safely run?

4. When boiling soda ash in a boiler to remove any oil which may be present, would you leave the manhole plate out on top or not, and why?

5. Why is it you can not employ an unbalanced slide valve on an engine with a shaft governor?

6. How would a cross-compound engine work if both cylinders were of like dimensions?

7. Why are the tubes of a Heine boiler flared after having been rolled?

ANSWERS

(a) A CORLISS ENGINE valve is given lap in order to prevent steam from blowing through to the exhaust when the engine is carrying the hooks. In other words, should the engine become overloaded, the governor would fall and the valves would not trip and cut off the steam before the end of the stroke, and if the valve was not provided with lap, steam would blow through the exhaust valve on part of the return stroke; but with lap, the valve is closed, even though the hooks have not tripped, before the piston starts on its return stroke.

(b) Lead is given the valve so that by having the valve open a slight amount before the piston reaches the end of its stroke, the piston may receive the maximum pressure in reversing its direction. The wider opening through which the steam can flow during the early part of the stroke tends to reduce the wiredrawing action.

2. An accumulator is not an integral part of a turbine but an apparatus placed between an engine and a low-pressure turbine. It is usually a cylindrical tank containing water which is kept in forced circulation mechanically or by the injection of steam. Steam collecting in the accumulator is condensed as it arrives in large quantities from the engine, and is again vaporized during the interval when the exhaust of the principal engine diminishes or ceases. The necessary variations for condensation and regeneration of the steam correspond to fluctuations in pressure in the accumulator, this pressure increasing when the apparatus is being filled and decreasing when it is discharging into the turbine.

3. For cast-iron wheels made in one piece, assuming a tensile strength of 20,000 lb. per sq. in. for a small test bar, and 10,000 lb. per sq. in. for large castings:

$$\text{Max. velocity of rim (feet per second)} = \sqrt{\left[\frac{\text{Tensile strength}}{\text{Factor of safety}}\right] \div \text{[Weight of cubic inch.}}$$

$$V = \sqrt{\left[\frac{10{,}000}{10}\right]} \div 0.26 = 62 \text{ ft. per sec.}$$

4. In boiling soda ash in boilers, it is usually allowed to act with a pressure not to exceed 15 lb., and thus it is necessary to keep the manhole closed.

5. In the case of an unbalanced slide valve, the pressure of the live steam acting upon its outer surface results in a loss due to the friction that must be overcome in moving the valve.

A balanced valve is employed in the shaft-governor type of engine because of the fact that with a high or medium speed engine, the use of an unbalanced governor would result in large friction losses, and also because the valve friction would make it difficult for the governor to control the movement of the valve.

6. Under these conditions the high-pressure cylinder would transmit a greater amount of power to the shaft than the low-pressure cylinder, causing the engine to operate with a decidedly uneven motion.

7. The tubes of a Heine or other water-tube boiler are usually flared to provide additional strength to the joint.

W. P.

Problems in Work

A PILE DRIVER HAMMER weighing 4000 lb. is lifted a distance of 11 ft. in 2½ sec. How many horsepower are required?

2. Niagara Falls is about 160 ft. high and it is estimated that approximately 12,000 tons of water pass over these falls each second. How many horsepower should be developed?

3. What is the difference between work and power?

M. D.

ANSWERS

IF A WEIGHT of 4000 lb. is lifted a distance of 11 ft.—neglecting all losses—it would be required to expend 11 times 4000, or 44,000 ft.-lb. of work. This, you state, is accomplished in 2½ sec., so that the number of foot-pounds of work done per minute would be equal to 44,000 times 60 divided by 2½, or 1,056,000.

One horsepower is equivalent to 550 ft.-lb. of work per second, so that 17,600 ft.-lb. are equal to 17,600 divided by 550, or 32 hp.

2. Twelve thousand tons are equal to 2000 times 12,000, or 24,000,000 lb. With this weight of water traveling through a distance of 160 ft., there is expended 160 times 24,000,000, or 3,840,000,000 ft.-lb. of work.

As one horsepower is equivalent to the expenditure of 550 ft.-lb. of work per second, 3,840,000,000 ft.-lb. of work would be equal to this amount divided by 550, or 6,981,818 hp.

3. Work may be defined as the sustained exertion of pressure, or force, through space, while power is the time rate of doing work. O. H. H.

Blowing Down Boilers During Test

I AM WRITING you in regard to an argument which arose over an evaporation test. The water was metered as it came from the feed pump, and the coal was weighed when fed to the stokers. One shift evaporated 7.78 lb. of water to the pound of coal; the other, 6.75 lb. The first shift blew down the boilers twice and the second, not at all. Would blowing down the boilers have any effect on the test and would it increase the evaporation? C. F. B.

A. The blowing down of water from the boiler would increase the apparent evaporation per pound of coal without increasing the actual evaporation. The water which leaves the blowoff does not take up the heat of evaporation necessary to form steam, but only sufficient heat to raise it from the temperature at which it enters the boiler to that at which it leaves the blowoff.

This trick of blowing down a lot of water is a favorite one for unscrupulous testing engineers when they wish to make a big evaporation showing. The only way that two shifts could be satisfactorily compared would be to blow down the same number of times during each shift, at practically the same pressure and for the same length of time. A. L. R.

Elevator Defects

WHAT ARE the most common defects found in electric and hydraulic elevators? S. A. G.

A. This is a decidedly indefinite question to answer. Electric elevator service men say that defective service may be caused by either cable trouble, motor trouble or controllers that are improperly cared for. Again, there is a difference depending on whether the current is a.c. or d.c. No most common defect in service or apparatus is known to us.

A common defect in hydraulic elevator service is the creeping of the elevators when the operating lever is central. This irregularity is caused by bits of packing from the cylinder packing getting into the small ports that lead from the pilot valve to the main valve. W. P.

Condensate or Fresh Water?

ONE OF OUR 6,000,000-gal. pumping engines is fitted with a surface condenser of the suction type. When operating this unit, we have the choice of using this water over and over or wasting the bilge water and using all fresh water in the boilers.

Kindly advise me under which condition the life of the boilers will be the longer.

When feeding only fresh water, we are obliged to use boiler compound to prevent the formation of scale; when using the bilge water, no compound is necessary. W. V.

A. If the surface condensers in this plant are protected by oil separators, it is better practice to use the condensate. If you are not protected with oil separators there is danger of boiler troubles, and probably more serious troubles than the scale accumulation will cause.

I have examined internally, boilers in surface condensing plants which have been in continuous operation for 16 yr., and where the condition of the boilers was perfect. I have never seen any trouble whatever from the use of condensate from the surface condenser as boiler feed. F. F. VATER.

Operating a Disabled Compound Engine

IF, ON A cross compound engine, the low-pressure cylinder or valve gear became disabled so that that side could not be used, what would be the proper thing to do?

2. If the cards on a Corliss engine showed that the terminal pressure was greater than the back pressure, causing a loop, how would you overcome it?

ANSWERS

IF THE low-pressure cylinder or valve gear of a cross-compound engine becomes disabled, the best method of operation is to stop the engine, disconnect the low-pressure connecting rod from the crankpin and arrange the exhaust from the high-pressure cylinder to go directly to the condenser. This will not make it possible to run at full capacity of the engine, but will make it possible to carry a considerable part of the load.

If the engine is of light construction, it may be necessary to carry a lower vacuum or to reduce boiler pressure in order to avoid bringing too much strain on the reciprocating parts of the high-pressure cylinder.

2. If the cards on an engine show that the terminal pressure is lower than the back pressure, the wise thing is to lower the boiler pressure and permit the engine to take steam at a somewhat longer cutoff, so as to bring the terminal pressure up to the back pressure.

3. Load can be increased on the low-pressure cylinder of a compound engine by decreasing the cutoff in the low-pressure cylinder. This will raise the receiver pressure and thus increase back pressure on the high-pressure cylinder and the initial pressure on the low-pressure cylinder, throwing the larger part of the load on the low-pressure cylinder. A. L. R.

Heavy Steam Consumption of Turbine

I AM OPERATING a 3000-kw. Curtis condensing turbine which of late has required an excessive amount of steam for starting. Could you perhaps tell me the probable cause of this? O. W.

A. It is difficult for one to offer any definite cause for the unusually great amount of steam required to start your turbine without being able to investigate the case thoroughly. Probably your trouble is due to worn buckets, allowing the bypassing of an excessive amount of steam without doing any work, or then again, some part of the rotating element may be stuck or binding at some point so as to cause a great effort to start. In any event, the only thing to do in order to determine the cause would be to open the turbine and carefully examine all parts.

If you have access to a flow meter we would suggest you connect this to your main steam line and note the amount of steam required, both for starting and for

running purposes. We would then take the matter up with the General Electric Co. of Schenectady, N. Y., giving them these figures and explaining to them just how the machine acts. They will, we are sure, give you all the assistance possible to eliminate your trouble.

O. H. H.

Pounding in Refrigerating Machines

Do ALL refrigerating machines develop a heavy pound? If so, why? E. S. R.

A. Refrigerating machines should pound no more than any other machine. If there is a pound, something is wrong and the cause must be located and removed at once. Most common causes of pounding are: Piston striking at one or the other end of the compressor. As there is scarcely any clearance in some compressors, heating of the ammonia rod will cause this member to lengthen and strike the head. An exceedingly cold piston rod will often be the cause of striking at the frame end of the stroke. Second: Deranged or broken suction or discharge valve. Third: Admission of liquid ammonia to the compressor. Fourth: Loose piston. Fifth: Rod loose at crosshead. Sixth: Nut holding piston or rod backing off sufficiently to strike head. Seventh: Loose bearings.

A. G. SOLOMON.

Ammonia Compressor Clearances

WHY SHOULD a double-acting ammonia compressor have more clearance than a single-acting compressor?

2. Is there anything gained by the use of a long stroke ammonia compressor? R. H. C.

ANSWERS

VOLUMETRIC clearance of a double-acting ammonia compressor is greater than that of a single-acting machine because of the pockets of the 2 additional valves. Mechanical clearance is made greater, because striking must be avoided at both ends of the cylinder, as there is no safety head. And adjustment for wear of bearings may cause trouble unless there is some chance for variation in clearance.

2. Ammonia compressors are made with as long a stroke as possible to secure a comparatively high piston speed with the least number of revolutions, and to cut down the clearance percentage as much as possible. With a long stroke and small bore, there is less clearance volume than when the piston has a short stroke and large bore. W. P.

Protecting Cold Water Pipes

I WOULD BE glad to have you give me some information regarding the protection of cold water pipes running up from the ground outside of a building.

J. P.

A. The cold water pipe which is outdoors will, of course, if it stands for a long time with no water flowing at all, become cooled to the point of freezing the water, no matter what insulation is put around it.

Probably the best method of insulating is to put on a good asbestos pipe covering and then box in the pipe outside the covering so as to keep this away from the weather. Rain, snow and ice will injure the asbestos covering quickly.

Presumably it might serve your purpose simply to put a box around the pipe and fill this box with some loose material. Ground cork is good, or closely packed excelsior. Sawdust is frequently used, but is not so good because of holding the moisture and being likely to cause rusting of the pipe. In any case, the box should be made large enough so as to give 2 or 3 in. of material around the pipe and should be made water-tight so that moisture cannot collect in the insulating material.

Wrapping the pipe in wool-felt, say 1½ in. thick, then covering this with canvas and putting on a heavy coat of water-proof paint on the outside of the canvas, is also a good method.

The main thing is to get from 1½ to 3 in. of insulating material around the pipe, and then protect this material from the weather so that it cannot get wet. With such an insulation, if water is kept circulating in the pipe during the cold weather, there should be no difficulty from freezing. A. L. R.

The Down Draft Furnace

WHAT IS a down draft furnace and what are the advantages claimed for it? SUBSCRIBER.

A. When speaking of a down draft furnace, reference is usually made to one in which, as its name implies, the draft is downward instead of upward as in the ordinary form.

In the Hawley down draft furnace, a foot or more above the ordinary grate there is carried a second grate composed of a series of water tubes, opening at both ends into steel drums or headers, through which water is circulated. The coal is fed on this upper grate and as it is partially consumed, falls through it upon the lower grate, where the combustion is completed in the ordinary manner. The draft through the coal on the upper grate is downward through the coal and the grate. The volatile gases are therefore carried down through the bed of coal, where they are thoroughly heated, and are burned in the space beneath, where they meet the excess of hot air drawn through the fire on the lower grate.

It is stated that in some tests conducted in Chicago, from 30 to 45 lb. of coal were burned per sq. ft. of grate upon this system, with good economical results.

O. H. H.

Steam Turbine Questions

WHAT IS the essential difference between a steam turbine and a water turbine?

2. Why would a turbine having a single wheel have to run at a very high speed?

3. In practice, how is the turbine designed to avoid such high speeds?

ANSWERS

THE CHIEF difference between the steam and water turbine is a matter of speed and also, as the friction is greater between the fluid and the buckets, the openings through the water turbine are made larger and, of course, all parts are made heavier.

2. The reason that a turbine with a single wheel has to run at high velocity is that the speed of the wheel

where the buckets are placed must be about half the velocity of the steam in order to get the best results. The steam, after expansion, will have a velocity of some 1400 ft. a second for non-condensing turbines, and 3000 ft. a second for condensing turbines. This means that the buckets on the wheel must run at about 700 ft. a second for non-condensing, or 1500 ft. a second for condensing turbines where a single wheel is used.

3. This difficulty is overcome by using several wheels in series. With two wheels they can run at half the speed necessary for a single wheel, or with three wheels at one-third the speed. The steam passes to one set of buckets, then through reversing buckets on to a second set of buckets, and so on. A. L. R.

Operating Three-Phase Motor on Single-Phase Circuit

WILL YOU advise how I may operate a three-phase motor on a single-phase circuit?

F. H. K.

A. Ordinarily a three-phase alternating-current motor cannot be connected to and operated on a single-phase circuit.

You will, of course, find it possible, in case of an emergency, to run such a motor on only one phase of a three-phase circuit. This frequently happens due to accident or otherwise, such as blowing of the fuse on one of the legs of a three-phase circuit, in which event the motor will continue to run, but it will be found that such a motor will develop but a trifle over 50 per cent of its rated horsepower.

If you have a single-phase circuit, the only thing you can do is to obtain a single-phase motor; otherwise the performance will be very unsatisfactory.

O. H. H.

Refrigerating Capacities of Ammonia Compressors

WILL YOU kindly send me a formula for figuring the tonnage in work done by an ammonia compressor?

R. A. F.

A. There is some disagreement among authorities as to the method of computing the refrigerating capacity of an ammonia compressor, but the simplest and probably as reliable a formula as any is as follows:

Tons capacity in 24 hr. $= D^2$ L N times 0.000,182;
where D is the diameter of the compressor cylinder in inches;
where L is the length of the stroke in inches;
where N is the number of revolutions per minute.

This assumes a double-acting compressor running at the standard pressures of 185 lb. on the compression side, 15.7 lb. on the suction side, and using 5 cu. ft. of ammonia per minute per ton.

For the absorption system, no method has been standardized for computing the capacity. This will depend on the amount of liquor handled by the liquor circulating pump, the pressure in the condenser, the pressure in the refrigerating coils and the per cent of ammonia in the poor and rich liquor.

If we assume what is reasonably good practice, that the rich liquor is 33 per cent ammonia, the poor liquor 20 per cent, the temperature in the refrigerating coils is zero, the temperature in the condenser 84 deg., which corresponds to 150.8 lb., we would get that the tonnage is equal to the number of pounds of ammonia liquor pumped per minute multiplied by 68.5. The pounds per minute pumped will depend, of course, on the size of the ammonia pump and the speed at which it is run.

In figuring the work actually done by a refrigerating system, the only way to get at this is to determine the amount of heat abstracted per 24 hr. by the ammonia handled and divide this by 284,000; which is the number of B.t.u. required in 24 hr. to give one ton refrigeration.

A determination of the heat taken up by the ammonia per pound is rather complicated, and we would advise you to get Siebel's "Compend of Refrigeration" and read it for information on these points.

Oil in Gas Engine Cylinder

THE TROUBLE of C. E. N. of the W. Va. T. & E. Co. and as related on page 871 of the Nov. 1 issue is common with vertical gas engines. Although the pistons have new rings, new pistons may be required, being too loose or worn they may allow the oil to work through. But, admitting that the pistons and rings are in good condition, it is possible that all the rings are crowded at the upper part of the piston and none at the lower part. If it is possible to add one at the lower end, it will help because that ring will have the first chance to scrape much oil off the cylinder walls. Some pistons have the lower edge with a pronounced level, so that the oil will not be scraped off; in such case the piston may be put on the lathe and about ⅛ in. cut off which would not harm at all. Often piston rings are so loose in their grooves that much oil goes by; they also get carbonized and stuck so hard that the last ring does not function at all.

In nearly all vertical gas engines of the splash type, to avoid trouble the level of the oil must be ascertained to a certain degree of accuracy, and often it pays to put in a glass gage, and the oil level kept to within ⅛ in. variation, I never let any part of the connecting rod dip over 3/16 in. in the oil.

Keep the mixture as lean as you possibly can, as there is nothing worse for the spark plugs than a rich mixture with an excess of oil.

Be sure you have a good spark. The best is purplish in color; when the spark is white, there is trouble coming. A good spark keeps points clean.

CHAS. LABBE.

I NOTE an article by C. E. N., West Virginia Traction & Electric Co., in which he says that he gets too much oil past his pistons in a gas engine. As this engine has been in use for the past 10 yr., it is possible that the cylinder has been worn to such an extent that an oversize piston is his only remedy and no amount of new rings will correct it. Of course, there is a possibility that there might be a mistake in the sediment that is on the piston and spark plug; that is, it might be burned carbon, caused by bad carboration, but if it is mucky and soft it is due to oil. The gas that we get now ranges

anywhere from 50 to 62 and is much heavier than that for which his carburetor was designed; 10 yr. ago we got gas at about 70 to 74.

I would suggest that the rings be removed and then two slips of ordinary writing paper eased down on each side of the piston and if they will go, a new piston is needed.

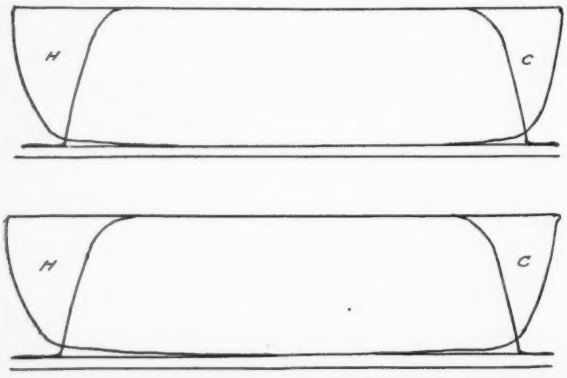
To get the diameter of the piston, a micrometer is the best; but few plants are equipped with little more than a monkey wrench and hammer, and fairly good work may be done by taking a small stick with a common pin in each end, the stick being about ½ in. less than the diameter of the cylinder, so one pin can be moved in or out till the diameter is found; then lay the pin stick on a machinist scale that is graduated to sixty-fourths of an inch and a very small error will be made if carefully done; and a new piston can be ordered from the measures so found. Insomuch as the engine is vertical it is not likely that the cylinder is out of round, if so it will have to be rebored.

An oil of a heavier grade might make a temporary relief. I think this remedy will work well on the other engine referred to by him. Sometimes kerosene oil is used to remove the carbon from cylinder and in most cases after it has been used it will cause the engine to pump oil and foul the plugs.

If he has any reason to believe that the carburetor is not performing properly or that he has a leaky intake valve, a good way is to slip a piece of hose on the cold air intake to the carburetor and hold the other end to his ear; if the intake valve leaks a whistling sound will be heard, and of course, the only remedy is to grind in the valve, or tighten the spring as the case may be; if the spring is weak a screwdriver point pushed into the coils and twisted would cause the engine to pick up speed. A very good way to examine the valve is to take it out and using a soft lead pencil make a few vertical lines on the valve face then replace the valve and turn it once around and if the marks are not entirely gone the valve needs grinding; if the valve seat is rough or the valve face a reseating tool is necessary, as it would require a lot of work to grind out a very small scratch with emery. HUGH L. RUSSELL.

Ammonia Compressor Cards for Criticism

SHOWN HEREWITH are two diagrams taken from a York piston valve type of ammonia compressor having dimensions of 13 by 12 in. and operating at a speed of 70 r.p.m.

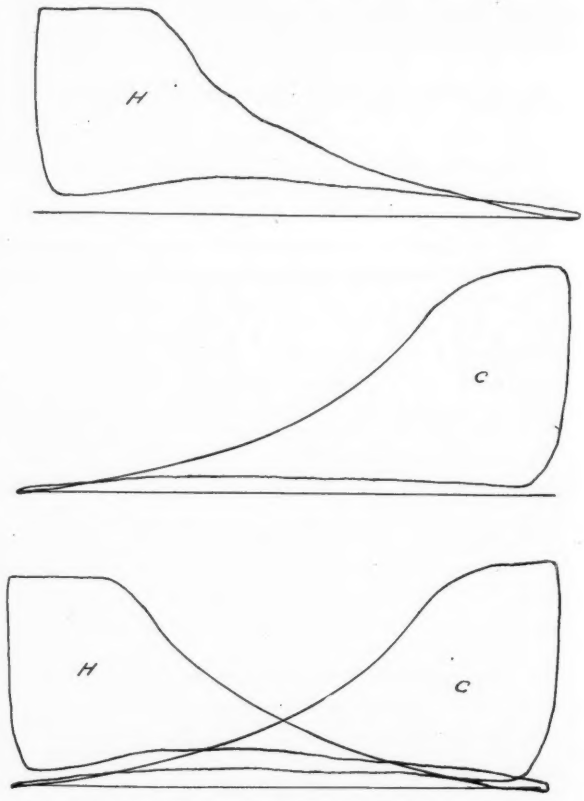


CARDS TAKEN FROM YORK PISTON VALVE TYPE AMMONIA COMPRESSOR

Will the readers of Power Plant Engineering please examine these and submit their opinions? G. P. H.

Nordberg Engine Cards for Criticism

SHOWN HEREWITH are three indicator cards taken from the low-pressure side of a 25 and 40 by 36-in. Nordberg long range cutoff cross compound Corliss engine, operating at a speed of 120 r.p.m., and direct connected to a 600-kw. generator. These cards were taken after the low-pressure cylinder and the four-valve chests had been rebored and a new piston and new valves installed.



CARDS TAKEN FROM LOW-PRESSURE SIDE OF NORDBERG ENGINE

G. D.

Factors in Safety Valve Formula

THE MASSACHUSETTS RULES formula for finding the area of opening of direct spring loaded safety valve is

$$A = \frac{W\,70}{P} \times 11$$

Where A is the area in square inches per square foot of grate surface, W is the weight of water in pounds evaporated per square foot of grate surface per second, and P is the absolute pressure at which the safety valve is set to blow.

What do the figures 70 and 11 represent, or are they both constants? S. W. V.

A. The rule for the area of safety valves as given in the Massachusetts Rules is taken from Napier's for-

mula for the flow of steam through an orifice. That formula was founded on experiment, and was as follows:

The pounds per second issuing from an orifice equal the absolute pressure times the area, in square inches, divided by 70. Transposing this gives the area as equal to the weight per second times 70 divided by the absolute pressure. This would be for a free opening through the valve.

Inasmuch as the lift of a safety valve is small, it is found by experiment that the area of opening in the valve, taking account of the friction, must be 11 times as great as that derived from the formula, in order to discharge the required weight of steam. That is the reason that the two constants are used, in order to show the derivation. A. L. R.

Why the Check Valve?

WHAT IS the purpose of the check valve on the return line of a low-pressure boiler?

2. What are some of the dangers attending the settling of the front wall of a horizontal tubular boiler?

J. J. O.

ANSWERS

WITH REFERENCE to the check valve on the return line of a low-pressure boiler, its chief purpose is to prevent the pressure in the boiler, if excessive, from backing water up into the heating system of the building. No other reasons for its installation are known.

2. When the front end of a horizontal tubular boiler settles, it permits sediment to accumulate, due to imperfect drainage, which will form a heavy scale on the shell over the fire. It is also apt to create a strain on the boiler connections.

If the front wall settles without changing the position of the boiler, an entrance may be provided for cool air which will seriously interfere with the proper combustion of the fuel. W. P.

Reviving Dry Cells

HOW CAN I put new life in run-down dry batteries?

A. B. J.

A. The matter of attempting to revive run-down dry cells is one which, while extensively employed, has been found not to pay, for in the long run it will be more economical to purchase new batteries.

Should you, however, desire to revive any such cells, we would suggest that you punch holes in the zinc outer casing and set the cell in a can of water. This will bring life back to the cell for at least a short time, although not to an extent equal to that when the battery is new.

O. H. H.

Effect of Oil in Exhaust Steam

I SHOULD LIKE to know what harm would result, if any, to either or both system or boiler, where exhaust steam is used for heating, to let the steam from engine and pumps go directly into the heating mains without first going through an oil separator or in some way having the oil removed from the steam. J. S. C.

A. The difficulty with using exhaust steam direct from engines and pumps into heating mains is that the oil carried over will form a coating on the inside of the piping, radiators and heating coils, and this coating of oil—which it is almost impossible to remove—greatly reduces the effectiveness of the heating surface, as it is non-conducting.

A good oil separator in the exhaust line will remove practically all of the oil, particularly if this separator is made of the receiver type and has ample capacity.

Thickness of Engine Cylinder Walls

WHAT IS the rule to determine the required thickness of material for the walls of steam engine cylinders?

C. H. R.

A. A convenient approximation for the thickness of engine cylinder walls is: $t = 0.0004\ Dp + 0.3$ in., in which t = thickness in inches; D = diameter of cylinder in inches; p = maximum pressure in pounds per square inch.

Allowance is made for a tensile strength of cast iron of 12,500 lb., with a factor of safety of 10, and 0.3 in. for reboring. W. P.

Excessive Compressor Clearance

WHAT WOULD BE the effect of excessive clearance in the cylinder of an ammonia compressor?

T. W. P.

A. In the mechanical action of a compressor having too much clearance, there would probably be nothing to show any irregularity. The pressure during compression would rise more slowly than it should, and the amount of gas discharged each stroke would be less than it ought to be. Also, the suction pressure would not get down to the point of drawing in fresh gas as quickly as it should, after the beginning of the suction stroke. The result would be a lessening of the capacity of the compressor, but the mechanical action would not be likely to show any particular variation from ordinary. A. L. R.

Yellow Gasoline is Good

IT IS SUGGESTED that our gasoline supply may be increased considerably if motorists will overcome an unwarranted prejudice against yellowish gasoline. In the early days of the oil industry poor refining methods were responsible for the production of yellowish kerosenes and gasolines, which were sometimes dangerous. This led the public to demand that gasoline be "water white," and the prejudice has hindered the development of cracking processes which produce perfectly safe gasoline with a slightly yellowish tinge. Another handicap in the industry, according to petroleum experts, is the necessity for refiners treating gasoline with sulphuric acid and caustic soda to remove unsaturated hydrocarbons which have high fuel value in an explosion engine. It is estimated that there is a loss of $10,000,000 a year in the United States through these prejudices, represented by 30,000,000 gal. of gasoline, 35,000 tons of sulphuric acid, and 3500 tons of caustic soda.

RECENTLY, in testing the strength of fish glue, a pull of 6030 lb. was required to separate the halves of a 1-in. wooden block that had been cemented together with this adhesive.—POPULAR MECHANICS.

POWER PLANT ENGINEERING

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Universal Military Training

No matter what our personal views may be toward war and under what conditions it should be waged, each and every one of us owes a debt to our government which has been formed and maintained by the labors and bloodshed of our forefathers. If not all we think it should be, it is our duty to put our ideals into definite practical shape and help make the government better; better, first, for ourselves; second, for those of other nations whom we adopt as citizens, and third, for those peoples outside our nation, presenting to them ideals of a nation that can be trusted to fulfill its promises, live up to its treaties, carry oppression to no one, yet, as a free-born nation, maintain its rights which have been agreed upon and adopted as international law.

During the early history of our government, there was an organization of soldiers called minute men, each fully armed and equipped and specially trained to give battle against any enemy of the community upon short notice. These men were volunteers; there is little need of forcing a man into action when savages are lurking in the woods about his home. The danger is evident and the advantages of co-operative action by able-bodied men of the community needs no debating. These men were, as a rule, accustomed to physical labors and outdoor occupations and their normal pursuits made them marksmen. No able-bodied man could well maintain the respect of his community without being a member of this organization of minute men. The country then had practically universal military training.

During the past eight months this country has been preparing to enter the fight. We have had little military training prior to declaration of hostilities; our peaceful occupations have unfitted many for the strenuous life of the soldier; as a nation we have felt too secure from the envious encroachment of other nations; and legislative bodies have either led or followed the people as a nation into a condition of unpreparedness for which we must pay dearly both in money and lives of our young men.

With the present start toward training an army and equipping it with modern means of warfare, no cessation of training should hereafter be allowed to occur so long as wars between nations are possible.

For the development of the individuals, for the growth of more patriotic spirit in the country and for the betterment of the nation there is no one measure that could be enacted by Congress more important than a reasonable law compelling universal military training of the young men of the country, and universal service of the nation by everybody at least one year of his or her youth.

As an individual the soldier receives a training in discipline and co-operation, fitting him for service in industrial organizations as well as military units; he gets accustomed to self-control, putting him in position to meet any duty without flinching; he is given a physical development secured in almost no other way. He will become, early in life, a citizen interested in good government, for he will know that the call will come to him to perform his duty as a soldier in case of war, hence will realize it as a patriotic duty to work at all times for a clean government which he will want to support.

We give full praise to those who in the face of national danger volunteer for military service even though they may not be trained as soldiers, but we have no right to expect a few of the bravest and most patriotic citizens to face death while others just as well fitted reap the benefits of their sacrifices. Share and share alike is a democratic principle. We should make it a permanent feature of our military service by adopting universal military training.

Air Over the Fire

As a result of its investigations, the Bureau of Mines gives the following deductions in regard to correct conditions for supply of air above the fire in a combustion chamber.

Only about 6.5 lb. of air per pound of coal burned can be forced through the fuel bed, if that is level and uniform. With a bed 5 in. thick, at least half the air needed for combustion must be supplied above the bed, and for thicker beds, a larger proportion.

Since hydrocarbons are distilled at the surface, and are unstable so that they can be broken up and burned only for a short time and at high temperature, this air should be supplied as near to the surface of the fuel bed as possible, preferably heated and in many small jets at high velocity to facilitate mixing with the unburned gases. Air added at more than 1 ft. above the bed loses much of its effectiveness.

As half of the combustion takes place in the combustion space above the fuel bed, this space should be of ample size, and the greater the percentage of volatile matter in the fuel, the larger should be the combustion space.

Unless the hydrocarbons are mixed with air within about a foot of the fire, they will decompose, forming soot, which makes black smoke, and this soot is deposited on striking the surfaces of the boiler—not formed on those surfaces.

This is novel doctrine, and one of greatest importance in securing complete combustion.

War-Savings Certificates

America has the reputation of being a wasteful nation and its citizens of being spendthrifts. Our money goes here, there and everywhere for pleasures, luxuries, to gratify curiosity or ride some hobby. The amounts may be individually small, but collectively the sum is large. Many people have not saved their surplus largely because of little incentive. We require about so much for food, clothing and shelter, lay aside a little for a "rainy day" and the rest goes hither and yon aimlessly.

In the present national emergency, the government has planned for gathering in this surplus from all sources, using it for carrying on the war and returning it with interest. The most recent offer by the Secretary of the Treasury is the sale to the people of the United States War-Saving Certificates, War-Saving Certificate Stamps and United States Thrift Stamps, by which means it is expected to raise some $2,000,000,000. These may be purchased at post offices and at numerous banks and other agencies. Advance sales began Dec. 3, 1917. The date of issue of all certificates so sold in December, 1917, will be deemed January 2, 1918.

A United States War-Savings Certificate, Series of 1918, will be an obligation of the United States when, and only when, one or more United States War-Savings Certificate Stamps, Series of 1918, shall be affixed thereto. Each of such War-Savings Certificates will have spaces for 20 War-Savings Certificate Stamps, Series of 1918, and each of such stamps thereto affixed will have a maturity value of $5 on Jan. 1, 1923, which will accordingly give each such certificate, when bearing its full complement of such stamps, a maturity value of $100. The name of the owner of each War-Savings Certificate must be written upon such certificate at the time of the issue thereof.

War-Saving Certificate Stamps, Series of 1918, will be issued in 1918 at prices from $4.12 in January to $4.23 in December, 1918.

The average issue price above fixed for the year 1918 with interest at 4 per cent per annum compounded quarterly for the average period to maturity will amount to $5 on Jan. 1, 1923.

Any owner of a War-Savings Certificate, at his option, will be entitled to receive at any time after Jan. 2, 1918, and prior to Jan. 1, 1923, at a money-order post office, upon surrender of his certificate, the amount he has paid for stamps plus accrued interest. War-Saving Certificates, however, are not transferable and will be payable only to the respective owners named thereon, except in the case of death or disability of any such owner.

Payments on account of War-Savings Certificates may also be evidenced by United States Thrift Stamps, having a face value of 25 cents each but bearing no interest. Thrift Stamps as such are not directly redeemable in cash, but each Thrift Card will have spaces for 16 Thrift Stamps, and a Thrift Card, when bearing its full complement of such stamps may be exchanged at a post office on or before Dec. 31, 1918, for a War-Savings Certificate Stamp, Series of 1918, and upon such exchange the owner of such Thrift Card must pay the difference between $4 and the current issue price of War-Savings Certificate Stamps during the month in which such exchange is made.

Here is an opportunity for everybody to serve his country and in doing so make a saving for himself out of money otherwise needlessly spent. We might suggest to those concerns that practice giving bonuses to employes that War-Savings Certificate Stamps be given instead of cash, thus encouraging savings as well as giving a substantial aid to the government.

WHEAT AND MEAT saving are being observed generally, to the credit of the nation, but reports from dealers indicate that hotels and restaurants are leading our homes in the effort to help our allies and our soldiers. The decrease in Tuesday orders for meat is for hotels, 30 per cent, for restaurants, hospitals and institutions, 25 per cent, for schools, 25 per cent, for retail trade and homes 12.5 per cent. It would seem that we still need something more of the spirit of personal sacrifice and more active public opinion against the use of meat on Tuesdays by individuals and private families, for their orders are largely placed on the day the meat is used, and surely more than 12 per cent of our people are willing to forego meats on one day in the week in order that our army may be effectively fed and our allies have some meat rather than none.

Skilled Workmen Wanted for Aviation Service

FOR the further extension of the aviation branch of the United States Navy, Secretary Daniels has authorized the enlistment of 8000 young men and in doing so has opened up most attractive opportunities in this new and unusually appealing service. There is an important and immediate need for mechanicians for Naval aviation for the ratings of machinists' mates, carpenters' mates, quartermasters, coppersmiths and blacksmiths. These men will not be enlisted for pilot's duties, but coming into the service with a general mechanical turn and a liking for the work they will receive a special and unusual training for the building, handling, repairing and overhauling of the Navy's air craft. Succeeding in this they will be used as the ground personnel of the flying corps.

The requirements for enrollment will be the same as those for the regular service of the United States Navy. Training for machinists' mates and quartermasters will last about three months. Carpenters' mates will train for approximately six weeks. On completion of training course the provisional landsmen, after examination, will be rated first or second-class petty officers on the basis of examination and all-around ability. After getting a rating they will be eligible for promotion to the next higher grade if they show fitness and pass the necessary examination. Promotion in the aviation field is unusually fast. The age limit for this enlistment is 21 to 35 years and each candidate will receive the U. S. Navy physical examination and not that required for flight duties. Men enlisting for aviation duty, but failing to qualify, will, if recommended by their commanding officers, be assigned to general service.

The following trades are covered by the ratings, carpenters, woodworkers, machinists, coppersmiths, fabric workers, riggers, acetylene welders, gas engine overhaul men and instrument makers. Requirements for the various classes of landsmen to be enlisted are:

Landsman for Quartermaster; although no previous trade experience is required a general manual ability is required. Men of trades such as rigging, fabric working and wire working are desired as are also men experienced in the operation of hydrogen plants or in the care and upkeep of dirigibles or balloons. Men in this training who display proficiency on dirigible work will be assigned to this branch. These men will also be used as sea-plane riggers, for general structure and overhauling and also inspection of dirigibles preliminary to flight.

Carpenters' mates will look after the upkeep and repair of wings, pontoons, flying boat hulls and bodies, balloons, and dirigibles, their training covering the practical application of their trade skill and general aviation work.

Machinists' mates will show previous experience in gasoline engines or any allied skilled trade, such as that of electrician. These will be charged with the upkeep and overhaul of aircraft engines. Their training covers a practical understanding of aircraft engines.

Provision is made for men especially well qualified for enlistment or enrollment as carpenters' and machinists' mates to be enrolled directly for that second-rate, should their skill be sufficient. The rating badge for men in this service will be the same as the regular except for the addition of double wings.

News Notes

E. E. JONES, who was with the Peerless Rubber Mfg. Co., has been appointed Superintendent of Power Plants with the Union Traction Co. of Indiana. Mr. Jones will have charge of power plants at Anderson, New Castle, Winchester, Eaton and Portland.

W. F. TRENARY, JR., has succeeded W. R. Jennison as representing the Harrison Safety Boiler Works, of Philadelphia, in southern territory, and has his headquarters at 419 Brown-Marx Building, Birmingham, Ala. Mr. Jennison is no longer with the company.

CHICAGO SUPERHEATER CO., an Illinois corporation, has been formed to engage in the manufacture of locomotive, marine and stationary superheaters, also independently stoker fired superheaters. Charles F. O'Connell is president and treasurer, Edward A. Geoghegan is vice-president and mechanical engineer, and N. L. O'Connell is secretary. The company's offices are located in the First National Bank Building, 38 S. Dearborn St., Chicago.

L. F. HAMILTON, for many years with the National Tube Co., and before that identified with the advertising of the Kewanee products, is now associated with the Walworth Mfg. Co., at Boston, Mass. This company has purchased the Kewanee Works of the National Tube Co., and Mr. Hamilton will, as before, be associated with the promotion of Kewanee products, in particular supervising the training of specialty students and the sales promotion work. W. L. Schaeffer, who has been Mr. Hamilton's assistant, will take charge of the advertising for the National Tube Co.

THE EVENTFUL and useful life of William D. Kearfott was cut short on Nov. 12 at the age of 53.

Although well known in the marine field as an outspoken, capable, and respected engineer, it is not so well known that he was an entomological authority of international reputation, his particular specialty being Micro-Lepidoptera. He was so actively interested in this science that his private collection of small moths surpassed any other private collection in the United States, and was said to be the second largest in the world. Literature on the subject has been made richer by a number of books and monographs from his pen. He was at one time requested by the American Museum of Natural History to rearrange and improve their collection—an honor that would be envied by any scientist. The Smithsonian Institution included him as a member.

In the engineering profession, Mr. Kearfott began work with the Morton Pool Co., of Wilmington, Del. Later he was associated with such well-known manufacturers as the International Navigation Co., the Worthington Steam Pump Co. and the Warren Steam Pump Co. At the time of his death, he was head of the Kearfott Engineering Co., 95 Liberty St., New York, which he organized 2 yr. ago.

Besides being a member of several Montclair clubs and the Machinery Club, Mr. Kearfott was a member of the Society of Naval Architects and Marine Engineers and the American Society of Mechanical Engineers.

Above all else, he was a true and loyal friend, always ready to carry more than his share of life's burdens.

Catalog Notes

W. J. LAWRENCE & ASSOCIATES, Spitzer Bldg., Toledo, Ohio, will be glad to receive from all manufacturers of lighting, heating, power and water plant apparatus, catalogs for their reference library.

SAVE COAL in the Boiler Room and Help Win the War is the heading on a poster sent without charge to power plant engineers by the Fuel Engineering Co. of 106 E. 19th St., New York City.

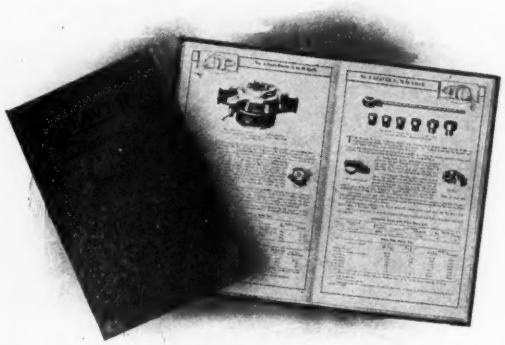
CHRISTMAS CAMPAIGN EDITION of Monthly Sales Service, published by The Society for Electrical Development, Inc., 29 W. 39th St., New York, was lately received.

BULLETIN D-1301, illustrating and describing Deane automatic pumps and receivers, has just been issued by Worthington Pump & Machinery Corporation, 11 Broadway, New York.

A NEW BOOKLET illustrating a complete line of grease cups and giving a list of their probable applications, is being sent out by The Wm. Powell Co., of Cincinnati.

YEOMANS electrically driven condensation return pumps for automatically returning condensation to boilers in low-pressure steam heating systems are described and illustrated in Bulletin C-5000 of Yeomans Brothers Co., 231 Institute Pl., Chicago.

THE BORDEN CO., Warren, Ohio, has just issued its 1918 catalog of "Beaver" easy working die stocks and square-end pipe cutters. This catalog is said to be the finest tool catalog ever issued, and its attractive



appearance indicates that no expense has been spared in securing the services of the best artists and printers. This book is printed in two colors, on high grade paper, and illustrates in a complete and artistic manner the complete line of "Beaver" easy working die stocks and square-end pipe cutters. Several new "Beaver" tools are shown for the first time in this catalog—one of the most popular of these being the new No. 3 "Beaver" Junior ratchet die stock, which is built on the unit plan to thread pipe from ⅛ to 1 in., inclusive. While this expensive catalog is not intended for general distribution, The Borden Co. will undoubtedly send a copy to any of our readers who will write a letter or card stating that they are interested in "Beaver" tools, mentioning Power Plant Engineering.

TWO NEW CATALOGS recently received from the Badenhausen Co. deal with marine and stationary boilers, respectively. They show in detail the principle of operation of this boiler, and the main features of construction, also how the boiler is arranged in connection with different commercial makes of stokers. They are books of interest to engineers who have to do with marine or stationary engineering, are well written and are finely printed. They may be had by writing to the Badenhausen Co., Philadelphia, Pa.

VALVE SPECIALTIES for the automatic regulation of pressure are the subject of Catalog 9, recently received from G. M. Davis Regulator Co., of Chicago. This catalog, whose cover design is illustrated herewith, contains 70 pages on the Davis pressure regulator or

reducing valve and many other types of the company's valves, illustrating and describing also specific valves installed in various plants and giving steam tables, engineering and other data.

A COMPLETE DESCRIPTION of hydro pressure recorders is contained in Catalog D recently received from Bacharach Industrial Instrument Co., 422 First Ave., Pittsburgh, Pa. This pamphlet also illustrates the various types of Hydro draft and pressure recorders, together with use and application in the different fields of industry.

GETTING MAXIMUM Pulley Efficiency is the title of a pamphlet containing data and information compiled by The American Pulley Co., of Philadelphia. Copies will be furnished free by the company to engineers of industrial plants.

Trade Notes

NAGLE CORLISS ENGINE WORKS, of Erie, Pa., has opened an office at 39 Cortlandt St., New York City, in charge of Frank W. Richardson, the telephone number being Cortlandt 7268.

THE ROBERTS STEAM SPECIALTY CO., of Cleveland, Ohio, was recently incorporated to engage in the manufacture of high-grade steam specialties, including the Roberts Safety Water Column. Mr. F. Y. Roberts, who has had long experience in the water-column business, is president.

CONTRACT has been received by the Badenhausen Co., of Philadelphia, for 18 triple expansion marine engines of 1400 hp. each, which will be built at the company's plant in Bound Brook, N. J., known as the Bound Brook Engine & Mfg. Co. These Government contracts and others require large additions to the Badenhausen plants, as follows:

In the Bound Brook plant installation of two boilers and superheaters of 200 hp. each, a new brick stack, 125 ft. high, and several new machine tools. In the plants at Norristown and Bridgeport, Pa., an extension of 180 by 80 ft., with punches, shears, air compressors and other boiler making equipment. At Cornwells, Pa., a tract of 73 acres has been purchased, and a new boiler shop is being erected, the first building being 200 by 275 ft., the power plant containing two boilers of 400 hp. each, two compound engines, one direct connected to a two-stage compressor, the other to a 175-kv.a. generator, and a new brick chimney. The boilers are made by the Badenhausen Co., engines by the Bound Brook Engine & Mfg. Co., the air compressor by the Sullivan Machinery Co., and the chimney is to be built by the Alphons Custodis Chimney Co. It is estimated that all improvements will cost about $300,000.

REDUCING THE COST of operating motor trucks is a problem that confronts every organization where trucks are in use at the present time, when prices are doubling and there is an imminent probability of the scarcity of gasoline.

An invention that reduces cost and helps to overcome this difficulty is the Duntley Hydro Pneumatic Generator which is being manufactured by the Chicago Pneumatic Tool Co., and has proven successful in burning low-grade fuel. An instance of the use of this device is on two Little Giant trucks equipped with these generators, which are hauling meat from Chicago to the Naval Training Station at Great Lakes. This operates on a mixture of 60 per cent kerosene and 40 per cent gasoline, and makes about 35 per cent greater mileage than was obtained from the gasoline alone without the use of the generators. The round trip of 80 miles is made with 8 gal. of the 60-40 mixture, costing approximately $1.06 a trip for fuel. In operating around the city, an average of 12 miles per gallon is obtained. T. J. Hudson, sales manager of the motor truck department, Chicago Pneumatic Tool Co., is confident that, in the near future, the use of clear gasoline by motor trucks will become uncommon.

POWER PLANT ENGINEERING

Trade-mark, Reg. U. S. Pat. Off.

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PUBLISHED THE FIRST AND FIFTEENTH OF EACH MONTH

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Any advertiser is invited to examine our paid subscription lists and Post Office mailing receipts at any time.

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Half page, one year, each insertion, $38.50.

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Eighth page, one year, each insertion, $13.25.

Front cover, $175.00 per issue.

Other specified positions, regular rate plus 10 to 50 per cent.

Stippled plates used, but no heavy, black and white plates.

Classified Rates

Per line, 30 cents each insertion.

Advertisements in this section are inserted under regular headings.

No display type allowed, but the first three words may be set in capital letters.

About nine words make a line. Minimum space sold, two lines.

Under classification "Position Wanted," advertisements not exceeding four lines will be inserted once for subscribers free of charge.

All copy should be received at Chicago office 18 days before date of publication.

Circulation of this issue, 22,000.

Technical Publishing Co.

537 S. Dearborn Street

Chicago

Position Wanted

POSITION WANTED—By engineer with 11 years' experience in 325 hp. plant. Married. Steady and sober. Would like to get day work in Illinois. Address Box 497, Power Plant Engineering, 537 S. Dearborn St., Chicago, Ill. 11-15-2

POSITION WANTED—By young man as oiler in large central station, with 7 years' experience with Corliss engines up to 400 hp., d.c. generator. I. C. S. graduate on complete Steam Engineering. Age 27. Married. Best of reference. Will go any place. Address Box 493, Power Plant Engineering, 537 S. Dearborn St., Chicago, Ill. 11-15-2

POSITION WANTED—As helper or oiler in small or large plant. Will come at once. Sober and industrious. Will consider reasonable salary. Address Box 494, Power Plant Engineering, 537 S. Dearborn St., Chicago, Ill. 10-1-4

POSITION WANTED—By young man as oiler or assistant engineer in or around Chicago, with chance of advancement. Eight years' experince; ready to start work at a week's notice; references. Address Box 492, Power Plant Engineering, 537 S. Dearborn St., Chicago, Ill. 11-1-2

POSITION WANTED—By steamfitter with 17 years' experience at the trade. Can furnish references as to habits and ability to handle men. I am 33 years old. Married. Address J. H. D., 669 Wunderlick St., Barberton, O. 10-15-2

POSITION WANTED—By practical engineer of 15 years' experience. Am familiar with a.c. and d.c. generators and motors, also refrigerating machinery. Am 38 years old, married and strictly sober. Good references. E. W. Jones, Genl. Del., Metropolis, Ill. 11-15-2

POSITION WANTED—As engineer or oiler in power or ice plant. Have had 15 years' experience. Fred J. Waite, 659 Douglas Ave., Aurora, Ill. 10-15-2

POSITION WANTED—By a licensed operating engineer with 5 years' experience. At present employed, but would like to make a change and locate in or near Philadelphia. Will consider position as operating or chief engineer at $150 per month. Can furnish best of references from present employer. Address Horace D. Ferrell, Box 501, Marcus Hook, Pa. 10-15-2

POSITION WANTED—Chief engineer desires change of location. Competent to handle large plant. Experienced with a.c. and d.c. machinery, irrigating machinery, ammonia compressors (practical ice-maker), gas engines and air compressors. Can install and o repairs. Not liable to conscription. Address Box 495, Power Plant Engineering, 537 S. Dearborn St., Chicago, Ill. 10-15-2

POSITION WANTED—As chief engineer. Am familiar with a.c. and d.c. generators and refrigerating and steam heating plants. I desire change. I can furnish good references and have been with present employer about 4 years. Age 35. Single. Address Box 715, Middleton, Conn. 12-1-1

POSITION WANTED—As helper or oiler in small or large power plant; Illinois preferred. Some experience with steam engines. Good habits. Can give good reference. Edward Moehl, Granville, Ill. 12-15-1

Help Wanted

WANTED—Resident subscription agents in the following cities: Atlanta, Ga.; Cincinnati and Columbus, Ohio; Kansas City, Mo.; Los Angeles, Cal.; Louisville, Ky.; Newark, N. J.; New Orleans, La.; Portland, Ore.; St. Louis, Mo.; San Francisco, Cal.; Washington, D. C. This is an excellent chance for a hustler, who is familiar with power plant conditions, to turn his spare time into dollars. To such a one we offer a Real Opportunity. Write Subscriptin Department, Power Plant Engineering, 537 S. Dearborn St., Chicago, Ill. tf.

MANAGER WANTED—Steady young man with business, electrical and steam engine experience, to manage electric light and ice plant in town of 3,000. Salary $90 to start. Living cheap. Give education, experience and references. Man from Middle West preferred. This plant is owned by a syndicate with good opportunities for advancement. Missouri Valley Light & Power Co., El Dorado Springs, Mo. 12-15-2

Wanted

WANTED—Agents on commission to sell our shaking grates. We will install grates on trial or put it to test at our expense with any grate made. Address Armstrong Mfg. Co., Springfield, Ohio. tf.

WANTED—Agents handling engine and boiler room specialties in every section for side line paying large commissions. Give experience, line carried and territory covered. Box 381, Power Plant Engineering, 537 S. Dearborn St., Chicago, Ill.

WANTED—Marine boilers. We will pay cash awards for information that leads to a purchase by us of marine boilers of from 75 hp. to 250 hp. The Pittsburg Boiler & Machine Co., Pittsburg, Kan. tf.

WANTED—Agents who call upon engineers to sell positively the best pump valve on the market Commission basis. Excellent. Address Box 500, Power Plant Engineering, 537 S. Dearborn St., Chicago, Ill. tf.

For Sale

FOR SALE—BOILERS—Two 300-hp. Babcock Wilcox W. T. boilers, with Roney stokers, insured December 1, 1917, 160-lbs. steam pressure, practically new, $9,000. Also two 500-hp. Heine, $15,000. Power Machinery Exchange, Jersey City, N. J. 12-15-1

FOR SALE—I have several years' back numbers of Practical Engineer which I will dispose of at a nominal amount. Address M. B. Urquhart, First National Bank Bldg., Denver, Colo. 12-15-1

FOR SALE—Four-in. Dean Brass Tube Cleaner, used only once. Will sell cheap or trade for indicator. R. J. Stockton, Welsh, La. 12-15-1

FOR SALE—Atlas Engine, ready for prompt shipment and immediate use. Size 22x30, left-hand drive wheel, 12 ft. in diameter, 3-ft. face, shaft 10 in. in diameter with wheel governor. This engine was developing 500 hp. when taken from our plant and is in very good running condition. Will sell for $800. Address The Parker-Young Company, Lisbon, New Hampshire. 12-15-1

FOR SALE—Gas engine, 25 hp., run 11 months. A. Birch & Bros., Somerville, Mass. 12-1-3

Patent and Patent Attorneys

PATENTS THAT PROTECT AND PAY—Advice and books free. High references. Best results. Promptness assured. Send sketch or model for search. WATSON E. COLEMAN, Patent Lawyer, 624 F St. N. W., Washington, D. C. tf.

PATENTS—C. L. Parker, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the invention. Handbook for inventors sent upon request. Washington, D. C. tf.

PATENTS—H. W. T. Jenner, Patent Attorney and Mechanical Expert, 606 F St., Washington, D. C. Established 1883. I make a free examination and report if a patent can be had and the exact costs. Send for full information. tf.

A. P. CONNOR, Consulting Electrical and Mechanical Engineer, Attorney-at-Law and Solicitor of patents and Trade-Marks. Results guaranteed. 121 Carroll St., S. E., Washington, D. C. tf.

PATENTABLE IDEAS WANTED—Send for three free books. R. B. Owen, 28 Owen Bldg., Washington, D. C. tf.

INVENTORS, ATTENTION!—Practical patents developed—financed—promoted—for our members. Write for details. Inventors Co-operative Bureau, Lankershim Bldg., Los Angeles, Cal. tf.

TECHNICA LBOOKS

Technical Books

FREE ENGINEER BOOKS and power plant tools and specialties, for securing new subscribers for Power Plant Engineering. A dandy chance for the engineer with a little spare time to get some fine premiums. Send for free descriptive circular and terms. Subscription Department, Power Plant Engineering, 537 S. Dearborn St., Chicago, Ill.

MISCELLANEOUS

Miscellaneous

ENGINEERS, DO YOU WANT to utilizze your exhaust steam for heating or drying purposes with back pressure on your engine? If so, address Monash Engineering Co., 1413 Jackson Blvd., Chicago, Ill. tf.

Sparks From The Advertising Pages

Where Buyers and Sellers Meet

Buy *Certain* Performance

Efficient production or transmission of power depends upon the *certainty* of performance of every factor employed.

This *certainty* is secured only when guesswork and costly experimentation have been removed from every one of the factors that produce or transmit power.

No longer is there room in a competitive market for any power maker or power transmitter that does not do its work with invariable *certainty*. The occasional performer cannot stand up under competition, and so cannot survive the searching test of advertising.

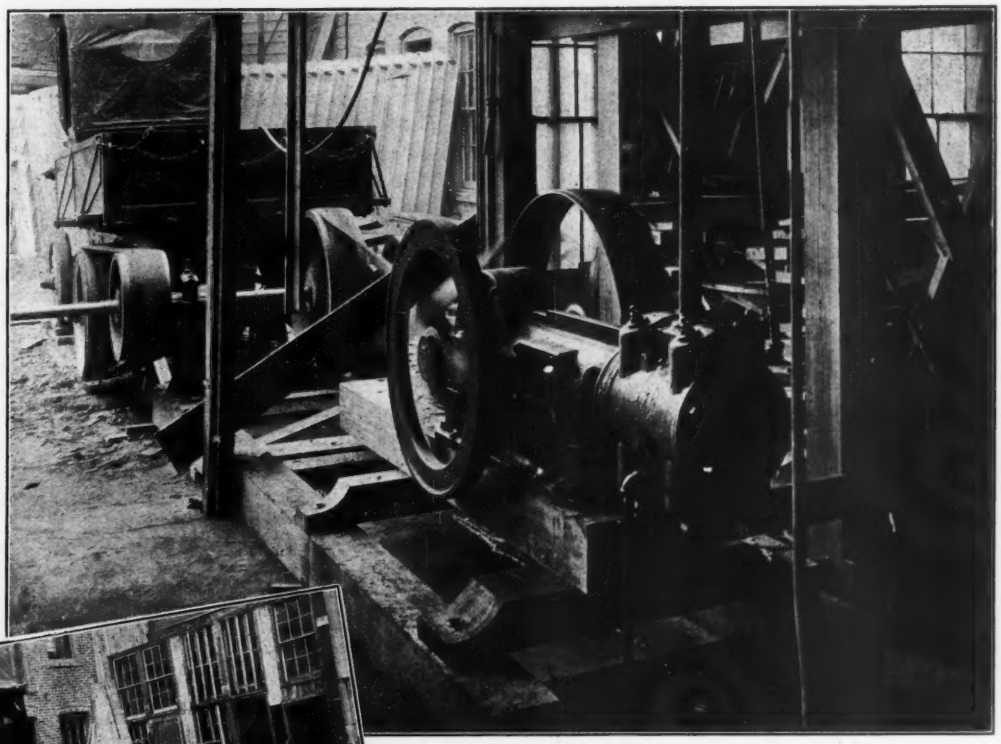
Publicity always betrays the worthlessness of the *uncertain* machine or method.

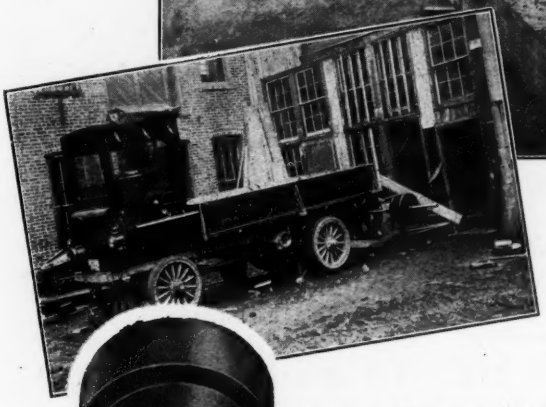
The buyer of power plant machinery, equipment and supplies can rest assured that hundreds of scientific men, years of time and untold thousands of dollars have been expended by the advertisers in POWER PLANT ENGINEERING on test room elimination and improvements.

Why not utilize these test room savings?—Why not profit by these scientific short cuts?—Why not force this composite test room to unfold its secrets for your benefit?

The advertising in POWER PLANT ENGINEERING is essential to any engineer who is seeking *certainty* in power performance.

Buy the *certain* performer—all else is *certain* trouble.





Using a Motor Truck to drive a Tube Cleaner

The Butler-Howell Company of New Brunswick, N. J., were certainly up against it.

Their boiler needed cleaning and they have a good cleaner—no better—a Liberty Cleaner.

But they only had one boiler and when it was shut down they were without means of operating a tube cleaner. The city water pressure was too low to operate a water cleaner; without the boiler they had no way of driving an air compressor.

But "where there's a will there's a way."

They took their powerful automobile truck, backed it up to the building and belted it to their air compressor. After trying various arrangements they found it best to use a countershaft and run a belt from each rear wheel of the truck, as otherwise it would not operate on account of the differential gears.

But when their automobile truck was properly belted up, they were able to run their air compressor—

And then, of course, the Liberty Cleaner cleaned their boiler as it always does—with rapidity and thoroughness.

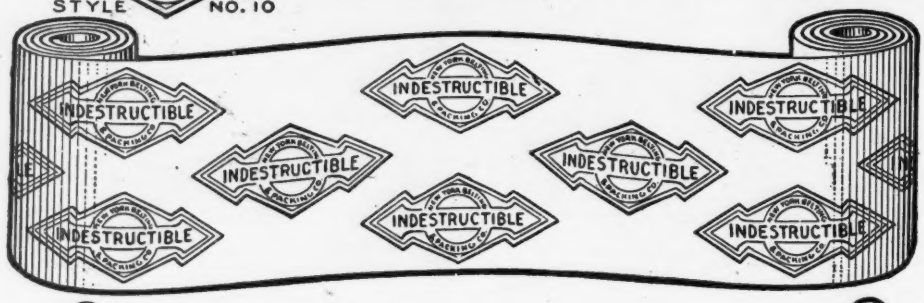
This is an interesting story, but it is not so interesting to you as that there's a Liberty Cleaner which will do your boiler cleaning thoroughly and efficiently, just as you want it done. Write for Catalog H, showing the complete line of Liberty Cleaners.

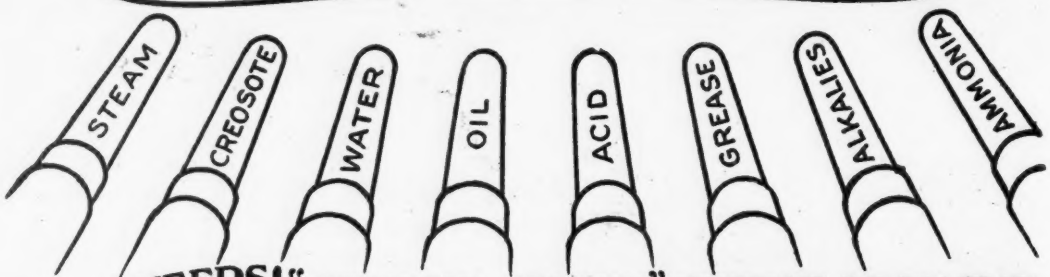
Liberty Manufacturing Company

6900 Susquehanna Street, PITTSBURGH, PENNA.

Preparedness!! that's us!!

INDESTRUCTIBLE — NEW YORK BELTING & PACKING CO.
STYLE NO. 10





ENGINEERS! "WATCHFUL WAITING" WHATEVER ITS POLITICAL ADVANTAGES, IS POOR POLICY IN POWER PLANT PRACTICE, BUT PREPAREDNESS IS "WATCHFUL DOING"

INDESTRUCTIBLE WHITE SHEET PACKING STYLE NO. 10 IS PREPAREDNESS!

ENTRENCHED BEHIND "FORT INDESTRUCTIBLE" YOU WILL BE SAFE FROM THOSE "GUNS" WHICH HAVE HERETOFORE IMPAIRED YOUR PLANT'S EFFICIENCY ~ CAUSED YOU NEEDLESS WORRY ~ MADE YOU WORK OVERTIME ~ SUNDAYS AND HOLIDAYS ~ FILLED YOUR EARS WITH HISSES AND WHEEZES FROM LEAKY PIPES. ~ FRIEND ENGINEER! GIVE INDESTRUCTIBLE PACKING A TRIAL, IT LIVES UP TO ITS NAME. IT'S A LABOR AND TROUBLE SAVER, A PERMANENT RELIEF FROM ALL YOUR PACKING DIFFICULTIES.

WRITE - WIRE OR PHONE FOR SAMPLES, PRICES AND FURTHER INFORMATION AND COPY OF OUR ENGINEERS CATALOGUE, SHOWING PACKINGS FOR ALL CONDITIONS OF SERVICE

NEW YORK BELTING & PACKING COMPANY.

NEW YORK, N.Y. 91-93 Chambers St.
CHICAGO, ILL. 124-126 W. Lake St.
PHILADELPHIA, PA. 821-823 Arch St.
PITTSBURGH, PA. 420 First Ave.
BOSTON, MASS. 65 Pearl St.
SAN FRANCISCO, CAL. 519 Mission St.
SPOKANE, WASH. 157 So. Monroe St.
ST. LOUIS, MO. 218-220 Chestnut St.

Spend Christmas with the Home Folks

Christmas is the day of all days that an engineer wants to spend with his wife and kiddies or with the old folks back home.

But many engineers have to waste the great holiday re-packing stuffing boxes, and only because ordinary rod packings —the sort that just can't make good— are used.

Get ready for the holidays—pack every stuffing box with P. P. P., and you will be free to enjoy Christmas and New Year, and, likely, also the Fourth of July for P. P. P. lasts for months—frequent instances show service of a year or more.

DANIEL'S ROD PACKING **P. P. P.** **FOR ENGINES, PUMPS AND COMPRESSORS**

Reg. U. S. Pat. Office

It is not a bit too early to prepare for your holiday. Get a pound or so of P. P. P. from your dealer and stuff every box in your plant. Then you can look forward to the celebration of the holidays confident that the days will not be spent in the engine room tinkering with blowing and leaky boxes.

To you and all the other engineers of America we extend our sincere wishes for your happiness and prosperity.

Thousands of you engineers have been our loyal friends for many years and we want you to know that the friendship is real on our part, too.

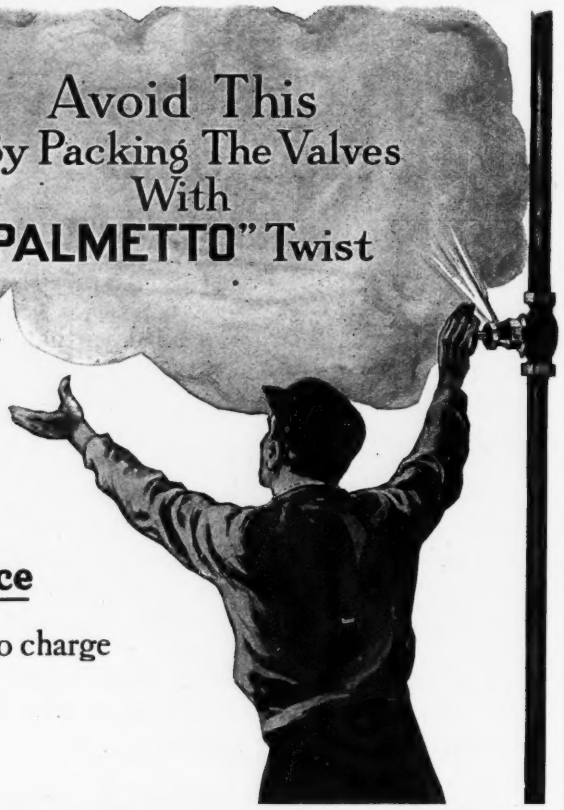
Gentlemen, we wish you and yours life's best.

QUAKER CITY RUBBER COMPANY

MANUFACTURERS OF MECHANICAL RUBBER GOODS

PHILADELPHIA	CHICAGO	PITTSBURGH	NEW YORK
629 Market Street	182 West Lake Street	211 Wood Street	53 Murray Street

Avoid This By Packing The Valves With "PALMETTO" Twist



A Single Spool Will Pack Any Size Valve

Unstranding gives any desired size. This is possible because each single strand is a perfect packing in itself.

"Palmetto" Gives Long Service

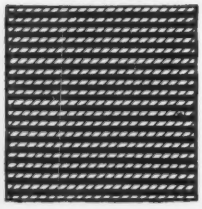
Let us send you a sample spool to test—no charge

Greene, Tweed & Co.
Sole Manufacturers
109 Duane Street New York

Skookum Packing

TEST it—that's the only way to tell! We've told you that *Skookum* is the *original* Diagonal Cross Expansion Packing—that it can be used in *any* kind of pump or engine—that it expands 100% in either direction under pressure—that it keeps the pressure where it belongs—and that it "may cost you a little bit more per pound but will certainly cost less per inch." Now—how are you going to prove all this unless you give *Skookum* a thorough, day-in-and-day-out test? To make it easy for you we'll send you a liberal test sample. Try it out as hard as you please—see how it "stacks up" to the packing you're using now—learn why the best engineers in the country specify *Skookum*. Don't forget that test sample—it's waiting for you; and it's free.

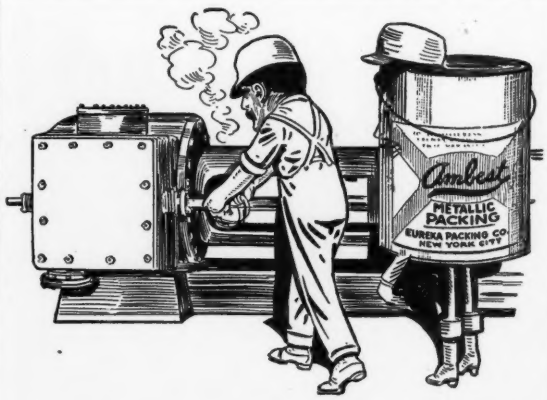
Cross Section of Ordinary Packing



Cross Section of Skookum Packing

BOWERS RUBBER WORKS
68-70 Sacramento Street
SAN FRANCISCO

There's a distributor in your vicinity



Ambest---The Time and Labor Saving Packing

Your packing troubles end when you start using "AMBEST" Lubricated Metallic Packing. If you have not yet tried "AMBEST," Do It Now. You can use it on Water, Steam, Oil, Ammonia, Air, Low or High temperature, Superheated Steam, etc., without any danger of it scoring, binding, fusing or hardening. "AMBEST," being composed of long strands of lubricated non-friction metal, is easily separated or formed to suit any good rod and box.

Easy and economical to use. You will see the wisdom of using "AMBEST" after reading full details of it in our literature, which we mail upon request.

Eureka Packing Company
79-81 Murray St. New York, N. Y.

VANDA PACKINGS

VANDA
A STEAM PACKING THAT IS A STEAM PACKING

PISTON

SQUARE
ROUND
SPIRAL
COIL

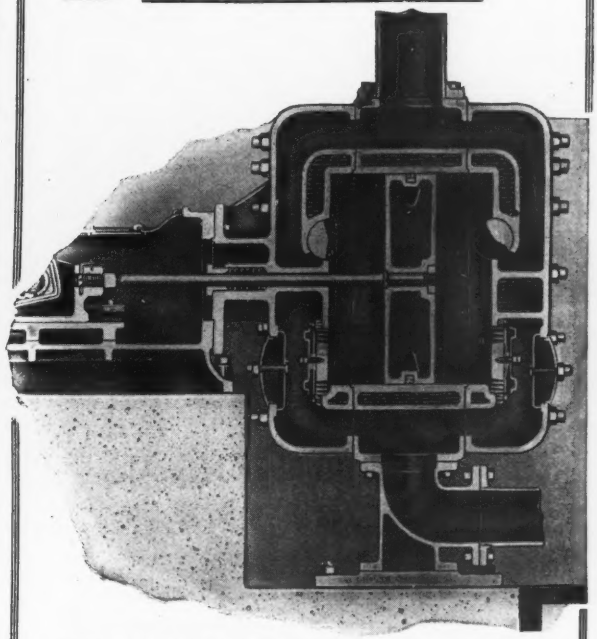
SHEET

The Original and Standard Fibrous Composition Packing--Highest Efficiency

Also Ammonia Packing.
Thoroughly Lubricated.

The Vanda Company
38 E. 25th Street New York

DANGER!



HEAVY Air Cylinder Lubricants quickly deteriorize, forming a crustation on valves and passages preventing proper valve seating—obstructing air intakes and discharge—causing overheating and not infrequently EXPLOSIONS.

KEYSTONE GREASE

Density No. 6 (LIGHT) thoroughly lubricates cylinders and neither carbonizes nor gums. Valves are always clean and free to move. Overheating due to poor lubrication is entirely eliminated and lubricant consumption is reduced to from one to two drops per minute. Density No. 6 (LIGHT) Keystone Grease is the result of years of experimentation and extensive experience in the field of Air Cylinder lubrication.

Arrange at once for a trial installation at OUR risk.

KEYSTONE LUBRICATING CO.

New York
Boston
Pittsburgh
Chicago
Savannah

Executive Office and Works:
PHILADELPHIA, PA.
Established 1884

New Orleans
St. Louis
Denver
San Francisco
Minneapolis

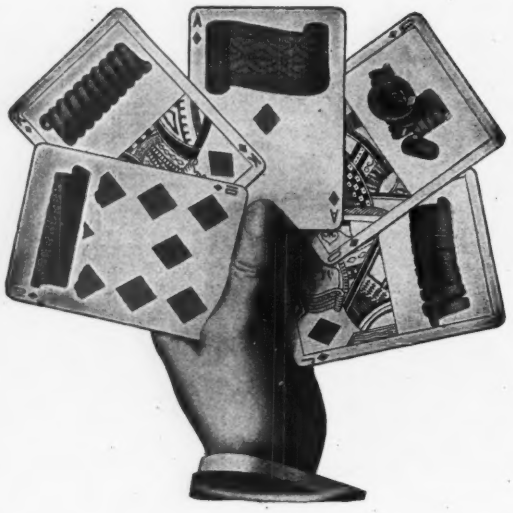
General Office and Warehouse for Great Britain, Manchester, England.

Continental European Office, Paris, France.

West Indian Office, Havana, Cuba.

Halifax, Nova Scotia.

KEYSTONE
TRADE MARK
Reg. U.S. Pat. Off.
GREASE



A Royal Flush

That Calls the Bluff On Imitations

Every Peerless Packing is built UP to a standard, not down to a price. They give service.

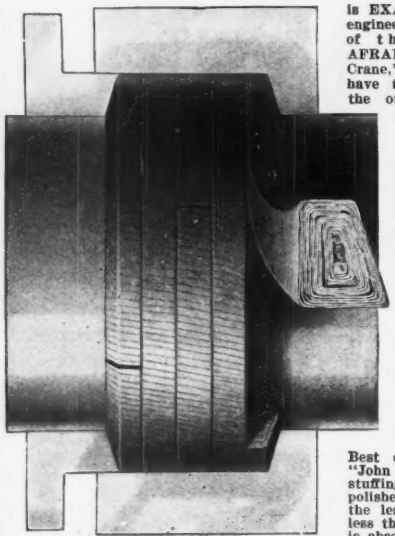
In these times when power plants are being forced to their limit it is policy to use the best packing you can buy—it means saving of power and time.

For Economy's Sake Use Peerless Packings

Peerless Rubber Mfg. Co.
New York

Branch Stores
Boston, Chicago, Minneapolis, Philadelphia
Stocks carried by good jobbers everywhere

FLEXIBLE METALLIC PISTON ROD PACKING



is EXACTLY what every engineer wants, but some of them seem to be AFRAID to try "John Crane," because they have tried OTHERS and the others have failed. Maybe YOU are in that same boat.

"John Crane" is DIFFERENT. It is made of smooth babbitt sheets spirally wound throughout from the very center to the outside. This view shows the construction pretty well, but it can't show how well "John Crane" WORKS. There's nothing better than a trial. Put "John Crane" on today, on a GOOD rod, and it will stay there for four, five, six or more years. Best of all, the longer "John Crane" is in the stuffing box, the more polished the rod becomes, the less the friction, the less the trouble. Leaking is absolutely STOPPED.

Can you beat these features?—ALL babbitt; hundreds of lubricated layers; easy conformity to the shape of any box; minimum friction; long life; no hardening, drying or rotting; good for high or low temperatures and high or low pressures; and equally adaptable to steam, air, ammonia, oil, gas, water, acids—anything.

Try "John Crane" ONCE, on a GOOD rod, and you will ALWAYS specify "John Crane" thereafter. Bulletin No. 1, which you should have, tells all about it.

CRANE PACKING COMPANY
27 S. Clinton Street, Chicago

"SAFETY" PLASTIC

METALLIC PACKING

FOR STEAM, WATER, AIR, GAS, ETC.

Pat. Dec. 22, 1903—Highest Award World's Fair, St. Louis, 1904

GUARANTEED TO LAST THREE YEARS

WITHOUT RENEWAL

Drop us a line and let us tell you all about this remarkable packing

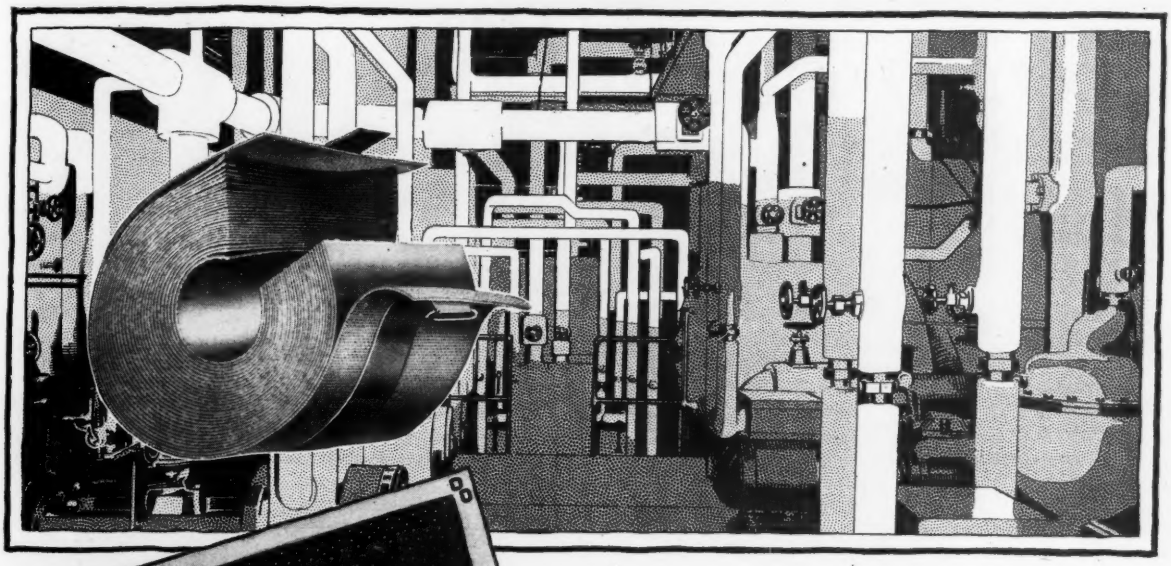
Steel Mill Packing Co. Established 1899 **Detroit, Mich.**

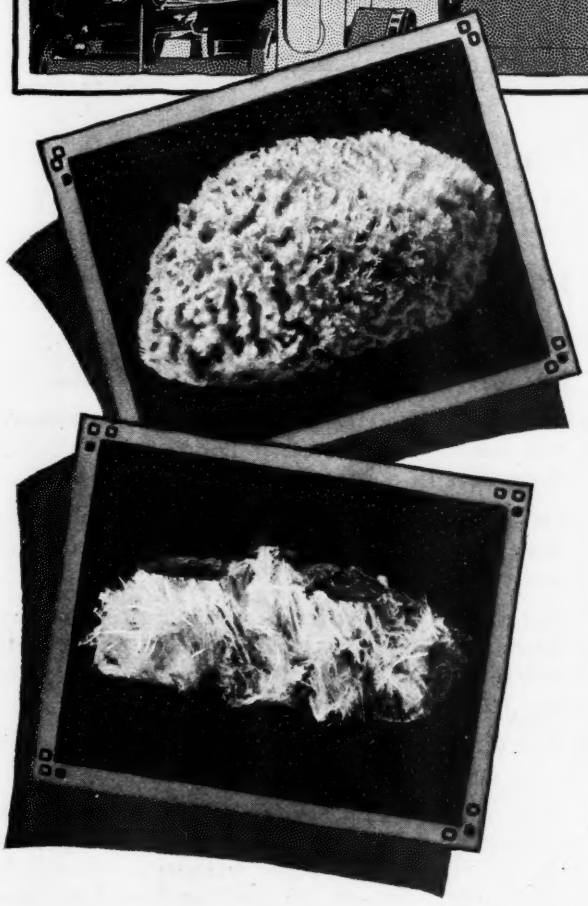
It Happened At East Point, Ga.

12 years ago. The Piedmont Cotton Mills ordered Holmes Metallic Packings Dec. 13, 1905. On Sept. 18, 1917 we furnished new rings. Its a cinch that they are satisfied.

Holmes Metallic Packing Company
Wilkes-Barre, Pa.
Incorporated 1897

The largest plant devoted exclusively to Metallic Packing in the world.





How earth and sea combine to contribute this most efficient pipe insulation

SPONGE from under a tropical sea and asbestos from the heart of earth—one an animal growth and one a mineral—a strange combination.

But they make the most efficient insulation on the market for steam piping. Sponge, because its innumerable cells hold dead air, and asbestos because this marvelous mineral, formed through centuries of heat and pressure, best withstands the ravages of high temperatures, of vibration and hard usage. And so, Johns-Manville Asbesto-Sponge Felted Insulation finds its way into countless power plants—achieves heat economy on hundreds of miles of piping and saves ton upon ton of costly coal.

There are other insulating materials which Johns-Manville build and recommend. There's a standardized, efficient Johns-Manville Heat Insulation for your every plant condition.

H. W. JOHNS-MANVILLE CO.
NEW YORK CITY
10 Factories—Branches in 55 Large Cities

JOHNS-MANVILLE SERVICE
COVERS THE CONTINENT

Johns-Manville Heat Insulation

Every Heat Unit Costs Money---

—More now than ever before, because of the high price of coal and labor. Hold every one of them—hold them in the condensation all over your plant and put them back into your boiler, for every one that escapes must be replaced through the use of more fuel and labor.

The Bundy Trap Will Do It—

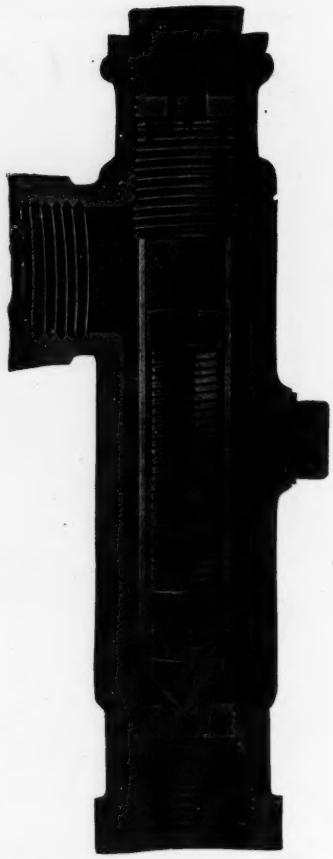
will put them back in the boiler, where they belong. That is how the Bundy Return Trap won its reputation for high efficiency and economy. That is how it is holding and adding to that reputation every day.

Not every trap will do this work—we know of no other that does it as thoroughly as the "Bundy." And the trap that doesn't do it is like a hole in the pocket where you carry your money.

Put a Bundy Trap on the job and try it out at our risk. Write for the Bundy Trap Book "E" and tell us the situation in your plant. Perhaps we can offer some helpful suggestions—that's what "Bundy Service" is for and there's no charge.

Nashua Machine Company
103 Main Street, Nashua, N. H.
William H. Rip'ey, New York Sales Agent, 5 Beekman St., New York

Trap Every Steam Line with a Sarco



High Cost of Steam
versus
Low Cost of Trapping

There was a time when steam was cheap. Not now. Now it costs more than at any time within a hundred years.

There was a time when all steam traps were expensive, big, cumbersome, troublesome things.

Not now. Now you can use the Steam Trap Sarco, which is small, low priced, absolutely efficient and reliable, and goes right on to any line anywhere.

Many an untrapped line steals the cost of a Sarco every week.

The Steam Trap SARCO relies on the expansion of a heavy hydrocarbon oil operating a Sarco Spiral Tube within a renewable cartridge. When steam reaches the cartridge, the trap closes and no steam escapes.

When condensation collects the trap opens and discharges it.

Write for further details and free Sectional Card Model

SARCO COMPANY, Inc.
Woolworth Building New York City
Buffalo Philadelphia Detroit Chicago
Representatives in All Principal Cities

METROPOLITAN INJECTORS

WHERE working pressures in power plants are so high that flanged fittings are required throughout, METROPOLITAN INJECTOR Model "T" is recommended.

This model is furnished with flanges of standard thickness for working pressures up to 200 lb. and the flanges to A. S. M. E. dimensions for pressures up to 350 lb.

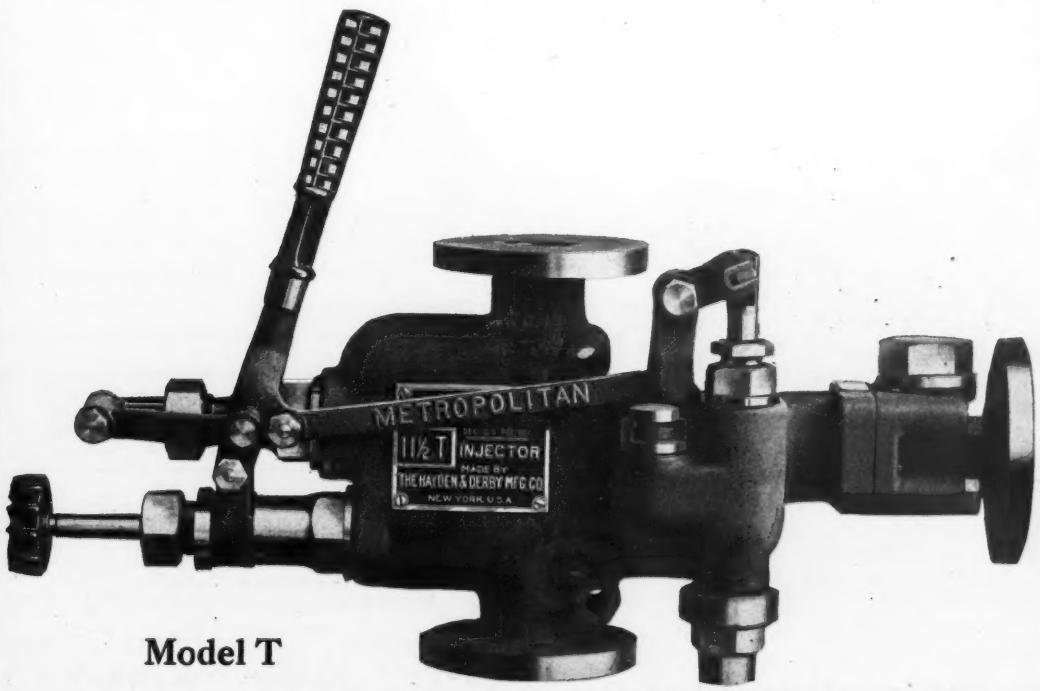
The Metropolitan Injector Model "T" is distinctly **high pressure** equipment.

It will handle hot feed water, operates on a long lift and, by an adjustment of the steam valve, its capacity can be regulated to within 40% of normal.

Metropolitan Injectors can be secured from any reliable jobber or contractor. Ask **them** what they think of the METROPOLITAN.

The Hayden & Derby Mfg. Co.

Chicago 119 W. 40th St., New York Boston



Model T

Empire Continuous Flow STEAM TRAP

Standard for Low Pressure Service

Note the inverted valve seat. It absolutely prevents any sediment lodging on seat, thus causing trap to blow or leak.

See the two inlets, one on either side. This makes it convenient for any piping arrangement. The one outlet in the end insures simple outlet connections.

Notice the automatic air valve. It operates by expansion and is so arranged that there is no air pocket.

Combine these features with an electroplated, seamless copper float tested to 150 lb. pressure, solid barbrass valve; valve seat, fulcrum, and float rod; interchangeable parts; ease of inspection without breaking any connections; and location of blowoff directly under valve seat.

Then, you know why this trap is the simplest, lightest, most inexpensive, and most efficient trap on the market.

Write today for prices. New Catalogue No. 9 just out.

AMERICAN DISTRICT STEAM COMPANY

General Offices and Works: North Tonawanda, N. Y.

NEW YORK CHICAGO SEATTLE

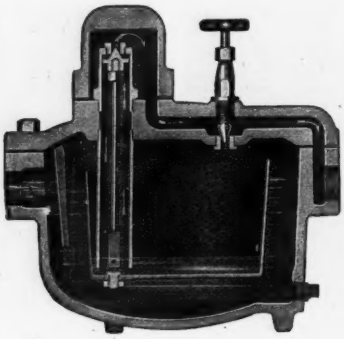
Kieley Steam Specialties

The Specialties of Quality

Manufactured by

Kieley & Mueller, Inc.

34 West 13th Street, New York, N. Y.



Steam Traps
Back Pressure Valves
Pressure Reducing Valves
Atmospheric Relief Valves
Tank Valves
Steam Separators
Oil Separators
Feed Water Heaters
Damper Regulators
Pump Governors
Stop and Check Valves
Water Feeders
Etc.

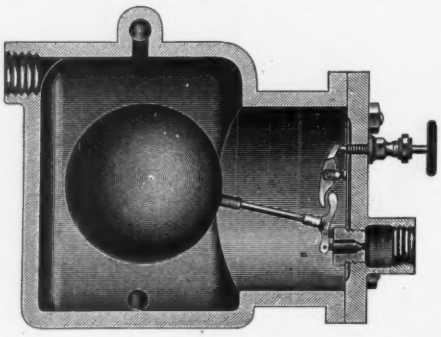
Distributors

Kieley & Mueller, Inc.

223 W. Erie Street, Chicago, Ill.

Frank A. Stevens Co., Los Angeles, Cal.
Bailey-Farrell Mfg. Co., Third Ave. & Ross St., Pittsburgh, Pa.
James J. Brogan, 810 Race St., Philadelphia, Pa.
L. C. Holmes, 705 Ouray Bldg., Washington, D. C.
G. P. Anderson, 65 Oliver St., Boston, Mass.

The Reliance for Capacity Efficiency and Durability in Steam Traps



RELIANCE Steam Traps have won the admiration of thousands of engineers because of the continuous dependabable service they render. RELIANCE Steam Traps are simple and trouble-proof. They are operated by a solderless copper float. The trap can be blown free of sediment or any obstruction in the valve. Steam leakage is impossible with the RELIANCE. All parts easily accessible. In every way a high-grade steam trap at a reasonable cost. We will mail our literature to you upon receipt of your request.

The Reliance Gauge Column Co.

72 East Prospect Street Cleveland, Ohio

Goetze No. 2 Gaskets

make perfect and permanently Tight Joints under the most severe conditions. Try them at our risk. We specialize in Gaskets and Packings. Consult us when in need. Whatever we Recommend, We Guarantee.

GOETZE

Gasket and Packing Co.

New Brunswick, N. J.

ASBESTOS

We are miners and shippers of Crude Asbestos in any quantity. We produce all grades at our world-famous BELL ASBESTOS MINES in Canada. We also card fibres, spin yarns, weave cloths, and make all sorts of Asbestos products.

For anything you want in Asbestos, turn to

Keasbey & Mattison Company

Ambler, Penna., U. S. A.

Dept. S-7

Owners of the World's Largest Asbestos Mines

The Genuine Squires STEAM TRAP Does the Work

Squires

Trade Mark
Reg. U. S. Patent Office

Let us send you one or more subject to your approval.
Write for Catalog E-9

The C. E. Squires Company
East 40th St. and Kelley Ave.
Cleveland, Ohio

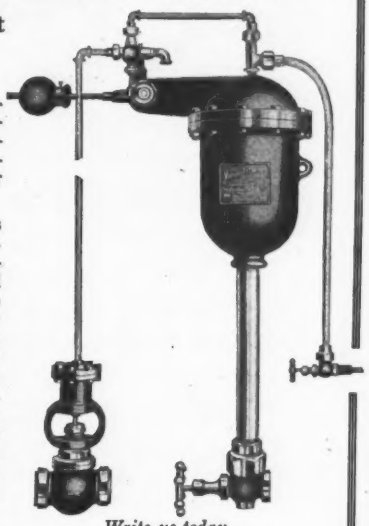
Avoid Too High or Too Low Water In Your Boiler

In either case it is unsafe and wastes a lot of fuel

Install a Vigilant Feed Water Regulator

and keep the water-level within one-fourth inch of center-gauge regardless of the load or method of firing.

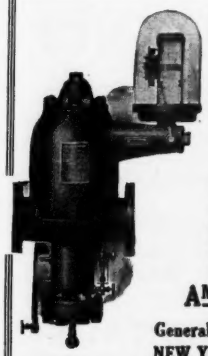
The Vigilant has no floats, no complex system of levers, toggles and small valves, no concealed parts or obscure steam passages. Nor does it depend upon the uncertainty of expansion and contraction. FREE TRIAL—the fact that it has more satisfied users than any other regulator makes us think it will please you.



Write us today.

The Chaplin-Fulton Mfg. Co.
42 Penn Ave., Pittsburgh, Pa.
Also Manufacturers of the Fulton Pump Governor

Represented by D. W. Patterson, Harrison Building, Philadelphia; J. E. Gimperling & Son, Dayton; Lord & Ward, Chicago; J. A. Grant & Co., Tremont Bldg., Boston; Harry F. Reynolds, 26 Cortlandt St., New York; Daniel E. Ford, San Francisco, Cal.



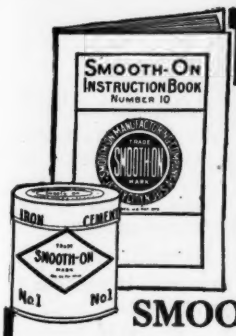
Keep An Accurate Record of the Steam You Use

Then you can compare one day's record with that of another, and economize accordingly. You can also detect and prevent the loss of steam.

The ST. JOHN
Indicating and Recording Meter

measures every cubic foot of steam, air or gas passing through it, and makes a continuous record each hour of the day. Measures all of the steam or gas all of the time. May we send your our catalog?

AMERICAN DISTRICT STEAM COMPANY
General Offices and Works: North Tonawanda, N. Y.
NEW YORK CHICAGO SEATTLE



SMOOTH-ON
Iron Cements

Permanently stop all leaks of steam, water, fire or oil; proved by years in use. New illustrated instruction book No. 16 free.

SMOOTH-ON MFG. CO.
JERSEY CITY, N. J.

FOR SALE BY SUPPLY HOUSES

Wherever there's an out-of-the-way valve—
there is a place for a
Babbitt
—Adjustable—
SPROCKET RIM

Makes inaccessible valves easy to operate—increases convenience—eliminates serious accidents due to ladders slipping—can be attached to any valve in a few minutes—a wrench is the only tool needed.

Ask your dealer about them or let us send a descriptive pamphlet giving full information.

BABBITT
STEAM SPECIALTY CO.
NEW BEDFORD, MASS.

YOU can depend on the

"S-C" FEED WATER REGULATOR

It never busies itself with anything but the task of efficient boiler feeding.

It never stops to talk or to look out of the windows.

And it never "fixes" the hand throttle in the feed line so that the water can swing from 6 in. to 18 in. without blowing the whistles—

For it concentrates all of its endeavors on scientific boiler feeding.

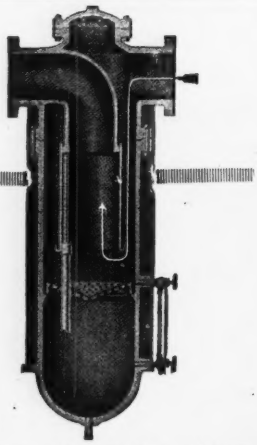
That's why it insures a more even flow of water through heater or economizer; a high average and more even steam pressure; higher average superheat caused by continuous boiler feed, and—

But why not send for Bulletin 50 and get its full story?

With fuel never higher, the need for the "S-C" Feed Water Regulator was never greater than it is today.

The "S-C" Regulator Co., Fostoria, Ohio, U.S.A.

Feed Water Regulation Engineers



Wet Steam Is Costing You Money

Wet steam helps to eat up the coal pile without producing maximum power. Maximum power can only be obtained when the steam is dry. Sweet's Steam Separators are separating the moisture from steam in thousands of power plants and delivering steam 99.8 percent dry. That power plant engineers have been pleased is evidenced by the fact that 50 percent of Sweet's Steam Separators have been sold on repeat orders. There is nothing complicated about them. The maintenance cost is low and little attention is required to insure satisfactory service year in and year out. Our catalog is yours for the asking. Send for it now.

The Direct Separator Company

Also Makers of Good Exhaust Heads and Flanged Fittings

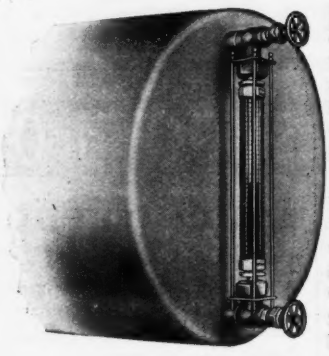
820 Geddes Street Syracuse, N. Y.

A TRIPLE ALLIANCE

is represented in the

Nason All-Iron Liquid-Level Gauge and Safety Gauge Glass

BECAUSE the Safety Attachment in the Gauge Cock Fittings closes instantly should the glass become accidentally broken. No escape of gas, liquid or fumes.



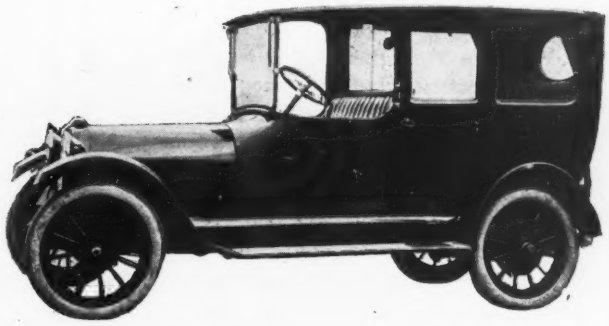
BECAUSE the Safety Glass is so installed in its housing as to render it even accidentally non-breakable

AND BECAUSE the Wire Guard prevents the escape of any fragments of the tube, should it be found possible to break it.

You see now why you should have it. If you don't need it, tell the fellow who does—you know him.

Nason Mfg. Co. 71 Fulton Street New York

Studebaker
Established 1852



Also Use

COPES BOILER FEED REGULATORS

The choice of a world famous concern over 65 years in business is not a mere accident.

Their plant is equipped with the Copes because the engineers in charge were satisfied that no better method of boiler feed control had been devised.

The automatic continuous feed is always graduated to meet the furnace load. Sudden changes in steam demand are always met by varying the rate of feeding in such a manner as to cause the most efficient absorption of the available furnace heat.

Their use means steady steam pressure, a fuel saving, higher average feed temperatures, higher superheat and fewer boiler repairs.

Get the full benefit of their use in your plant.

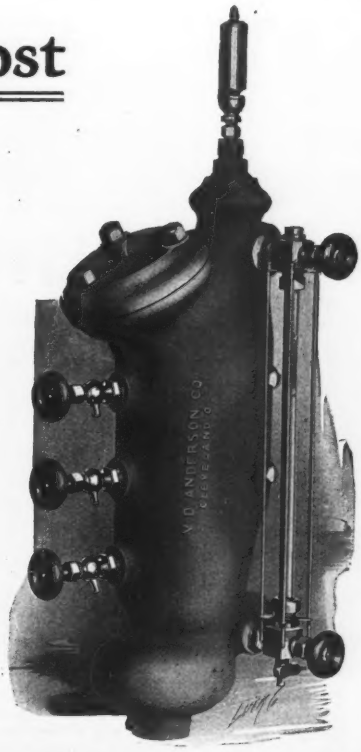
Send For Your Copy of Catalog

NORTHERN EQUIPMENT CO.
113 West 11th Street - - ERIE, PA.

Thousands of Dollars Lost

Thousands of dollars are lost yearly in power plants due to inefficient boiler feeding and boiler explosions. Where will the next boiler room disaster occur? No one knows. But if asked which of the power plants will not be endangered, one could readily answer—those power plants where the ANDERSON Safety Water Column with its gauge glass and whistle is ceaselessly safeguarding life, power and property.

The mechanism of the "ANDERSON" never forgets. The whistle of the "ANDERSON" does not let the boiler attendant or engineer forget. The gauge glass acts as a guide in the maintaining of a proper water level. The material and workmanship are up to the usual "ANDERSON" standard. If interested in efficiency, economy and safety, write for our illustrated catalog. Read it—Then Act.



The V. D. Anderson Company

1937 W. 96th. Street Cleveland, Ohio

We read the other day in a Feed Water Regulator advertisement, that it is a good thing for a machine to have but "one moving part." We think this is true, providing that one part (the valve stem), always moves as it should, and when it should.

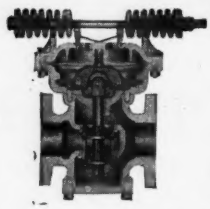
Why is it that valve stems do not always move? For the reason that no frictionless stuffing box that will stay tight has yet been discovered.

The Williams Boiler Feed Controller has no stuffing box. It gives a continuous feed according to intensity of fire and demand for steam. The water level operates it, regardless of steam pressure. Send for circular.

The Williams Gauge Co.
643-5-7 Fourth Ave., Pittsburgh, Pa.

FOSTER VALVES
Are Serving
On Land and Sea
The reason being—

"Reliability Their Main Feature"



This One Is Ready to Serve You

CLASS "W"

Its duty is High Pressure Regulation and once installed and adjusted you may depend upon a constant uniform lower delivery pressure from a higher initial pressure regardless of varying supply—for a Foster **never** shirks its duty.

Full details are explained in Foster literature. Send the word—Catalog.

FOSTER ENGINEERING COMPANY
Newark, New Jersey
180 No. Dearborn St., Chicago, Ill. 161 Summer St., Boston, Mass.
404 Arrott Building, Pittsburgh
712 Harrison Bldg., Philadelphia

CURTIS ENGINEERING SPECIALTIES

CURTIS
Improved Damper Regulator

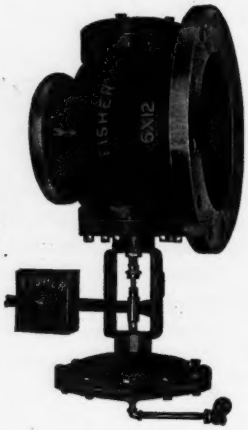
Is a device of unusual Simplicity, Durability and Power. Its operation is Positive and Automatic and it is Guaranteed to change the damper in either direction on a minimum variation of pressure. Therefore, it is a Fuel Saver.

Send for 1917 Catalogue.

Julian d'Este Company
26 Canal St., Boston, Mass.

Agencies:
216 Fulton Street, New York City
174 North Market Street, Chicago, Ill.

FISHER MEANS EFFICIENCY



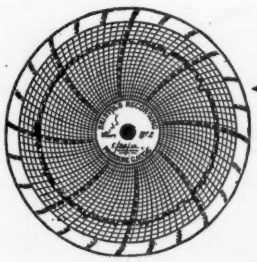
A Trouble Proof Reducing Valve

The Fisher Reducing Valve

Like all FISHER Steam Specialties, is trouble-proof. For service on steam, air, water, gas or oil it can be depended upon to give long, efficient service. It will reduce any initial power plant pressure to any desired low pressure in one reduction.

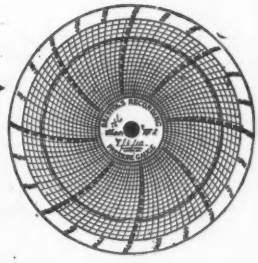
The FISHER Reducing Valve will not stick or chatter. We will be pleased to place it on trial for 30 days to prove its merit. Our catalog explains in detail the various FISHER Steam Specialties which have been on the market over 30 years. Send for a copy today.

THE FISHER GOVERNOR CO.
239 Fisher Avenue **Marshalltown, Iowa**



Before

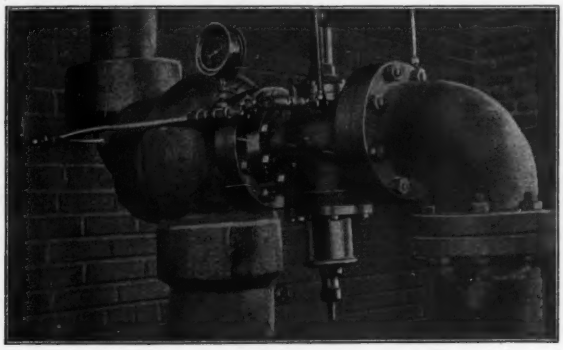
Before and After the Installation of a Mason Fan Engine Regulator



After

In the Plant of Springfield Gas & Electric Co., Springfield, Ill.

LOOK AT THOSE CHARTS



READ THIS LETTER

The Installation and a Letter About it.

The installation as shown in the accompanying halftone, and the results shown by the charts are clearly described in the letter reprinted herewith signed by Mr. Jas. C. Rounds, First Engineer of the plant.

The charts tell their own interesting story of the change from rapidly and continuously fluctuating boiler pressure to a pressure of almost absolute uniformity, and the letter certifies to the durability and generally satisfactory performance of the Mason Fan Engine Regulator, which caused the change and effected the saving.

If you have any problem to meet involving the Close, Positive, Automatic Control and Regulation of Steam, Air or Water pressures, we ask in your own interests that you give us an opportunity to apply to that problem the rich experience which we have gained through years of practice along these lines alone. Mason Service, an Advisory Engineering Service organized for that purpose, is at your command without charge. And it works just as readily and effectively AFTER the sale as before.

Springfield, Ill., Sept. 3, 1914.
Mason Regulator Co., Boston, Mass.
Dear Sirs:

I enclose you photo of one of your Regulator Valves.

This valve was installed in the Springfield Gas and Electric Company's plant in 1910.

We used forced draft—two fans 18 ft. diameter, driven by engines 14x14, running 60 to 125 r.p.m.

Before we put in these valves, had to regulate the draft by throttling the engine by hand or regulate with the dampers, and the steam pressure was very irregular, as our load was heavy on the boilers at times.

I enclose two steam charts, one taken before and one after the valve was put in.

We set the jack under the dashpot at 60 to 80 lbs., depending on the load, and the valve will regulate from what it is set at, to boiler pressure. If the boiler pressure drops, the valve speeds up the fan. The boiler pressure is almost constant, as you can see by the chart.

It has never given us any trouble, and all the repairs we have done on the valve is to put in new auxiliary valve and new diaphragm.

We have two of these valves, and they are both in constant use eight months in the year, during our heating season, and have made a big saving on coal. They have given entire satisfaction.

Respectfully,
(Signed) JAS. C. ROUNDS,
Springfield Gas & Elec. Co.

Write at once for the Mason Catalog, a 220-page book showing the Mason Line of Devices for the Automatic Regulation and Control of Steam, Air and Water Pressures. It is a valuable book and is yours for the asking.

Buy By This Mark

The Mark of Known Quality

Mason Regulator Company

Dorchester Center,

Boston, -:- Massachusetts

Buy By This Mark

The Mark of Known Quality

Royal rises to the occasion

Lighten the Work-Day With

ROYAL COTTON WASTE

The man who uses *Royal* saves time and energy.
The buyer who chooses *Royal* saves money.
It's *guaranteed* for Uniform Quality; 6% "Tare" (Wrappings); Even Weight.

A Grade for Every Need of Service or Price

SIX WHITE
Baron
Count
Czar
Duke
Earl
Emperor

SIX COLORED
King
Marquis
Mikado
Prince
Rajah
Sultan

Know your waste! Write for the free book—"*Producing the Fittest in Waste.*"

Ask your jobber or write for *Royal* Sampling Catalogue; also for samples of *Royal* Wool Waste.

ROYAL MANUFACTURING Co

GENERAL SALES OFFICES AND PLANT

RAHWAY, N. J.

New York Office—2 Rector Street
St. Louis Office—Pontiac Bldg.
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Pittsburgh Office—Oliver Bldg.
San Francisco Office—Wells Fargo Bldg.

LOOK FOR THE BRAND ON EACH STEEL BAND

Replace the link
Renew the fuse

ECONOMY
renewable
FUSES

cut the annual fuse maintenance cost 80%

When a fuse is blown, what do you replace – the entire fuse or just the fusible element?

There is no reason under the sun why you shouldn't enjoy the economy afforded by the Economy Fuse, which is renewable on the spot by simply inserting a new "Drop-Out" Renewal Link.

Millions in use by thousands of users, including leading powder, munitions and steel plants, U. S. Government and countless others whose first consideration is safety.

Write today for free samples and Catalog 25.

ECONOMY FUSE & MFG. CO.

KINZIE & ORLEANS STS. CHICAGO

Why the IDEAL Grease Extractor?

Check your impression of what you ought to have in a Feed Water Filter and Grease Extractor and see if they don't come pretty near to Lagonda specifications. Here are a few points:

(1) **Thoro Filtration**—in the Lagonda Grease Extractor, all water passes thru 5 separate and distinct layers of Terry Linen toweling—"Multiple Filtration."

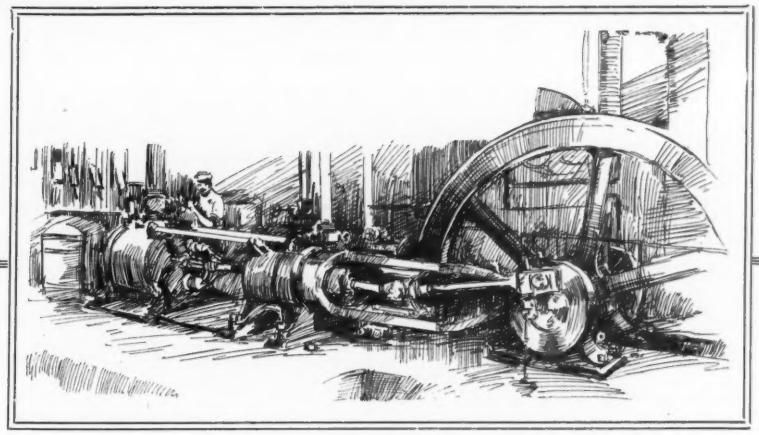
(2) **Continuous Operaion**—never have to take the Lagonda out of service. It has double capacity, two units—one in service, one held in reserve.

(3) **Easy to operate and clean**—raise the cover; pull out the filter spool; unroll spacing mat and Linen; roll on a clean length and replace. That's all there is to cleaning a Lagonda.

Just shift the gate valves to change units. Let us tell the whole story. Ask for Catalog Q-1.

The Lagonda Mfg. Co.
SPRINGFIELD, OHIO
FUEL SAVING SPECIALISTS
NEW YORK, BOSTON, PHILADELPHIA, ST LOUIS, CHICAGO, DETROIT, DENVER, DALLAS, SAN FRANCISCO, ST. PAUL, MONTREAL, LONDON

OTHER LAGONDA PRODUCTS
Boiler Tube Cleaners
Condenser Cleaners
Boiler Tube Cutters
Automatic Cut-Off Valves
Cap and Header Re-seating Machines
Cleaner Feeding Device.



Cylinder Lubrication

Have you ever considered why good lubricants are so essential? A powerful microscope will disclose hundreds of irregularities on a bearing surface, no matter how smooth it may appear to the naked eye.

DIXON'S Ticonderoga Flake Graphite

will fill up these minute irregularities and form a smooth, durable veneer of graphite that is practically frictionless.

It will give better lubrication, cut the oil bills in half and eliminate the wear and tear of machinery.

Dixon's Flake Graphite will restore cut and scored cylinders and valves to perfect smoothness.

Send for Booklet No. 96-C telling more about this lubricant and method of successfully feeding dry graphite into cylinders.

Made in JERSEY CITY, N. J., by the

Joseph Dixon Crucible Company

D X N TRADE MARK

Established 1827

D X N TRADE MARK

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Chief Engineer Wilson Talks About a Much Used Word

"It's on everyone's lips nowadays, this word. It's used by the butcher, the baker, the automobile maker. But just the same in its true sense it's one of the biggest words in the English language, the word—'Service.'

"Of course, it's my business to give it to the folks who work in this building in good heaping measure when it comes to the elevators. They must be kept going, not now and then, but all the time, day in and day out. An elevator out-of-order is a reproach to my service-giving abilities.

"One day when I was new at the job I noticed the word 'Service' sticking out of one of the Otis Company's advertisements. That interested me because it was right in my line of business and I read on about the Otis offices in every important city where they could give not just ordinary service but an expert, specialized service.

"Considering that the Otis people ought to know more about their own elevators than anyone in the city, that sounded sensible to me. I called up the nearest Otis office the next time I had a rather complicated job and they sent their man over here and the job was done better and in half the time it would have taken me. So now 'Service' has taken on a new meaning for me. Otis Service has come to be a new helper on my job."

The next time you have repair work to be done call up the Otis Service Office nearest you.

OTIS ELEVATOR COMPANY

Eleventh Avenue and Twenty-sixth Street, New York City
600 West Jackson Boulevard, Chicago
Offices in all principal cities of the world

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Gardner Governor Co., Quincy, Ill.
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Spray Eng'r'g Co., Boston.

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Reliance Gauge Column Co., Cleveland.
Williams Gauge Co., Pittsburgh.

ARC LAMPS.
Westinghouse Electric & Mfg. Co., Pittsburgh.

ASBESTOS GOODS.
Johns-Manville Co., H. W., New York.
New York Belting & Packing Co., New York.

ASH CONVEYING SYSTEMS.
Green Engineering Co., East Chicago, Ind.
Hofft Co., M. A., Indianapolis.
Link-Belt Company, Chicago.

BABBIT METAL.
Allan & Son, A., Harrison, N. J.
Bound Brook Oil-less Bearing Co., Bound Brook, N. J.
Cadman Mfg. Co., A. W., Pittsburgh.
Magnolia Metal Co., New York.

BEARING METAL.
Bound Brook Oil-less Bearing Co., Bound Brook, N. J.
Magnolia Metal Co., New York.

BELTING.
Bowers Rubber Co., San Francisco.
Goodrich Co., The B. F., Akron, Ohio.
Graton & Knight Mfg. Co., Worcester, Mass.
New York Belting & Packing Co., New York. "Carbon."
Peerless Rubber Co., New York. "Rainbow." "Fortune." "Durham."
Plant Eng'r'g & Equip. Co., New York.
Quaker City Rubber Co., Philadelphia. "Ironsides."
Schieren Co., Chas. A., New York.

BELT DRESSING.
Cling-Surface Co., Buffalo.
Crescent Belt Fastener Co., New York.
Dixon Crucible Co., Jos., Jersey City.
Graton & Knight Mfg. Co., Worcester, Mass.
Magic Leather Treatment Co., Detroit.
Quaker City Rubber Co., Philadelphia.
Stephenson Mfg. Co., Albany.

BELT LACING.
Crescent Belt Fastener Co., New York.
Flexible Steel Lacing Co., Chicago, Ill.

BELT LACING LEATHER.
Graton & Knight Mfg. Co., Worcester, Mass.

BELT FASTENERS.
Crescent Belt Fastener Co., New York.
Flexible Steel Lacing Co., Chicago, Ill.

BELT RIVETS.
Crescent Belt Fastener Co., New York, N. Y.
Flexible Steel Lacing Co., Chicago, Ill.
Mason Regulator Co., Boston.

BLOWERS, FAN.
Buffalo Forge Co., Buffalo.
Coppus Eng'r'g & Equip. Co., Worcester, Mass.
Nelson Blower & Furnace Co., Boston.
Wing Mfg. Co., L. J., New York.

BLOWERS, FURNACE.
Coppus Eng'r'g & Equip. Co., Worcester, Mass.
McClave Brooks Co., Scranton, Pa. "Argand."
Nelson Blower & Furnace Co., Boston.
Wing Mfg. Co., L. J., New York.

BLOWERS, TUBE.
Bayer Steam Soot Blower Co., St. Louis.
Diamond Power Specialty Co., Detroit.
Marion Mach. Fdry. & Supply Co., Marion, Ind.
Pilley Pkg. & Flue Brush Mfg. Co., St. Louis.

BLOW GUNS.
Robertson Co., Jno. F., Pittsburgh.

BOILER ARCHES.
Betson Plastic Fire Brick Co., Rome, N. Y.
M. H. Detrick Co., Chicago, Ill.
Harbison-Walker Refractories Co., Pitsburgh.
Jointless Fire Brick Co., Chicago.
Lamprey Co., The, Westfield, Mass.
McLeod & Henry Co., Troy, N. Y.
Quigley Furnace Specialties Co., New York.

BOILER BAFFLES, TURNER.
Engineer Co., The, New York, N. Y.

BOILER CLEANER—METAL TREATMENT.
Caldera Purga Co., Chicago.
Johns Manville Co., H. W., New York.
Perolin Co. of America, Chicago.

BOILER CLEANERS.
Hyette Co., The Paul B., Philadelphia.
Liberty Mfg. Co., Pittsburgh.
Lagonda Mfg. Co., Springfield, O.
Pilley Pkg. & Flue Brush Mfg. Co., St. Louis.

BOILER COMPOUND FEEDERS.
Fisher Governor Co., Marshalltown, Ia.
American Well Works, The, Aurora, Ill.
Babcock & Wilcox Co., New York. "Stirling," "Cahill," "A. & T."
Badenhausen Co., Philadelphia.
Erie City Iron Works, Erie, Pa.
Springfield Boiler & Mfg. Co., Springfield, Ill.
Wickes Boiler Co., The, Saginaw, Mich.
Union Iron Works, Erie, Pa.
Vilter Mfg. Co., Milwaukee.

BOOKS.
American Technical Society, Chicago.
Drake Co., Fred'k J., Chicago.
McGraw Hill Book Co., Inc., New York.

BOOSTERS.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Westinghouse Elec. & Mfg. Co., Pittsburgh.

BRUSHES, CARBON.
Dixon Crucible Co., Jos., Jersey City.
Le Valley Vitae Carbon Brush Co., New York.
Pilley Pkg. & Flue Brush Mfg. Co., St. Louis.

BRUSHES, DYNAMO AND MOTOR.
Dixon Crucible Co., Jos., Jersey City.
Le Valley Vitae Carbon Brush Co., New York.
Pilley Pkg. & Flue Brush Mfg. Co., St. Louis.

BRUSHES, WIRE.
Pilley Pkg. & Flue Brush Mfg. Co., St. Louis.

BUSHINGS.
Armstrong Mfg. Co., Bridgeport, Conn.
Bound-Brook Oil-less Bearing Co., Bound Brook, N. J.
Steel Mill Packing Co., Detroit, Mich.

CABLE, STEEL WIRE.
American Steel & Wire Co., Chicago-New York.

To Find the Manufacturers' Advertisements of Products Listed Here, See Index Page 68

BOILER COVERING.
Kearbey & Mattison Co., Ambler, Pa.
Magnesia Assn. of America, New York.

BOILER FEEDERS.
American Steam Pump Co., Battle Creek, Mich. "Marsh" and "American."
Dean Bros. Steam Pump Works, Indianapolis.
Gardner Governor Co., Quincy, Ill.
Nason Mfg. Co., New York.
Powell Co., The Wm., Cincinnati.

BOILER GRAPHITE.
Dixon Crucible Co., Jos., Jersey City.

BOILER SETTINGS.
Betson Plastic Fire Brick Co., Rome, N. Y.
Harbison-Walker Refractories Co., Pittsburgh.
Jointless Fire Brick Co., Chicago.
Johns-Manville Co., H. W., New York.
McLeod & Henry Co., Troy, N.Y. "Steel Mixture."
Quigley Furnace Specialties Co., New York.

BOILER TUBE CLEANERS.
Huyette Co., The Paul B., Philadelphia.
Lagonda Mfg. Co., Springfield, O.
Liberty Mfg. Co., Pittsburgh.
Pilley Pkg. & Flue Brush Mfg. Co., St. Louis.
Roto Co., The, Hartford, Conn.

BOILER TUBE EXTRACTORS.
Robertson Co., Jno. F., Pittsburgh.

BOILER TUBE PROTECTORS.
Cruise & Co., Eliabeth, N. J.

BOILER TUBES.
Mark Mfg. Co., Evanston, Ill.
National Tube Co., Pittsburgh.

BOILERS.
Allis-Chalmers Manufacturing Company, Milwaukee.
Goodrich Co., The B. F., Akron, Ohio.

CALORIMETERS, GAS RECORDING.
Foxboro Co., The, Foxboro, Mass.
Sarco Company, Inc., New York.

CEMENT, ASBESTOS.
Johns-Manville Co., H. W., New York.
New York Belting & Packing Co., New York.

CEMENT, BELT.
Graton & Knight Mfg. Co., Worcester, Mass.

CEMENT, IRON.
Johns-Manville Co., H. W., New York.
Paxson Co., J. W., Philadelphia.
Smooth-On Mfg. Co., Jersey City.

CHAIN BELTS.
Link-Belt Company, Chicago.

CHAIN PIPE WRENCHES.
Williams & Co., J. H., Brooklyn.

CHAIN WHEELS.
Babbitt Steam Specialty Co., New Bedford, Mass.
Crane Company, Chicago.

CHIMNEYS.
Heinicke, Inc., H. R., New York.
Springfield Boiler & Mfg. Co., Springfield, Ill.

CHAIN PIPE VISES.
Williams & Co., J. H., Brooklyn.

CHAIN TONGS.
Williams & Co., J. H., Brooklyn.

CHAIN PIPE VISE MOUNTS, PORTABLE.
Williams & Co., J. H., Brooklyn.

CLAMPS, ROPE.
American Steel & Wire Co., Chicago-New York.

CLOCKS.
Ashton Valve Co., Boston.
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn.

COAL AND ASH HANDLING MACHINERY.
Green Engineering Co., East Chicago, Ind.
Link-Belt Company, Chicago.
Sprague Electric Wks, New York.

COAL BUNKERS.
Link-Belt Company, Chicago.

COCKS, AIR AND STEAM.
Cadman Mfg. Co., A. W., Pittsburgh.
Dart Mfg. Co., E. M., Providence, R. I.
Lunkenheimer Co., Cincinnati.
Michigan Lubricator Co., Detroit.
Powell Co., The Wm., Cincinnati.
Williams Valve Co., D. T., Cincinnati.

COCKS, BLOW OFF.
Cadman Mfg. Co., A. W., Pittsburgh.
Powell Co., Wm., Cincinnati.
Williams Gauge Co., Pittsburgh.

COILS AND BENDS.
National Pipe Bending Co., New Haven, Conn.

COIL HEATERS.
National Pipe Bending Co., New Haven, Conn.

COMBUSTION APPLIANCES.
Defender Auto. Regulator Co., St. Louis, Mo.

COMBUSTION (CO_2) RECORDER.
Defender Auto. Regulator Co., St. Louis, Mo.
Sarco Company, Inc., New York.

COMBUSTION ARCHES.
Betson Plastic Fire Brick Co., Rome, N. Y.
Jointless Fire Brick Co., Chicago.
McLeod & Henry Co., Troy, N. Y. "Steel Mixture."
Quigley Furnace Specialties Co., New York.

COMPOUND, BOILER.
Caldera Purga Co., The, Chicago.
Dearborn Chemical Co., Chicago.
Plant Eng'r'g & Equip. Co., New York.

COMPOUND COMMUTATOR.
Ohio Grease Co., The Loudonville, Ohio.

COMPOUND, PIPE JOINT.
Dixon Crucible Co., Jos., Jersey City.
Johns-Manville Co., H. W., New York.
Smooth-On Mfg. Co., Jersey City.

CONDENSER CLEANERS.
Lagonda Mfg. Co., Springfield, Ohio.

CONDENSERS.
American Steam Pump Co., Battle Creek, Mich. "Marsh."
Anderson Co., The V. D., Cleveland.
Cameron Steam Pump Works, A. S., New York.
Dean Bros. Steam Pump Works, Indianapolis.
Griscom-Russell Co., New York.
Manistee Iron Wks., Manistee, Mich.
Westinghouse Electric & Mfg. Co., Pittsburgh.
Wheeler Cond. & Eng'r'g Co., Carteret, N. J.
Worthington Pump & Machinery Corp., New York.

CONDUIT, FLEXIBLE STEEL.
Sprague Electric Works, New York.
Westinghouse Machine Co., Pittsburgh. "Lebanon."

CONVEYORS.
Green Engineering Co., East Chicago, Ind.
Link-Belt Company, Chicago.
Otis Elevator Co., New York.

COOLING SYSTEMS.
Spray Eng'r'g Co., Boston.
Wheeler Cond. & Eng'r'g Co., Carteret, N. J.

COOLING TOWERS.
Wheeler Cond. & Eng'r'g Co., Carteret, N. J.
Worthington Pump & Machinery Corp., New York.

CORRESPONDENCE SCHOOLS.
American Technical Society, Chicago.

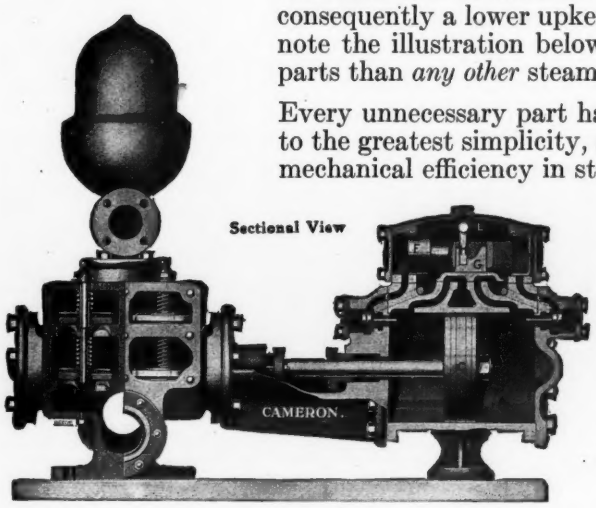
COUNTERS, REVOLUTION.
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn.
Starrett Co., L. S., Athol, Mass.

The Slogan of the Cameron—"Character: The Grandest Thing"

Simplicity is the Keynote of Cameron Design

This means a minimum number of working parts, less repairs and consequently a lower upkeep cost. Take a Cameron Pump apart or note the illustration below, and you will find it has fewer working parts than *any other* steam pump.

Every unnecessary part has been eliminated. Its design is reduced to the greatest simplicity, and represents the highest development of mechanical efficiency in steam pump design.



Sectional View

Cameron Pumps

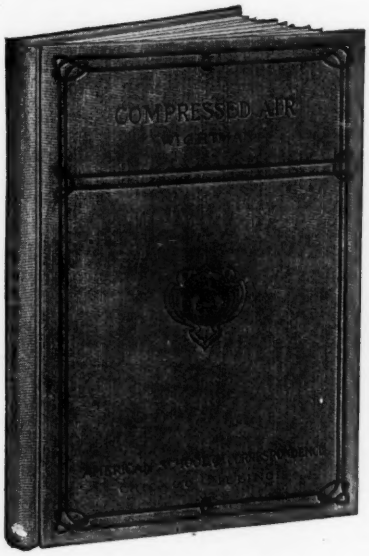
Are strong, sturdy and serviceable, representing 50 years of pump building—50 years of valuable experience and unparalleled success that insure durability and reliability in every pump that leaves our works. You may pay more for a Cameron in the beginning, but it costs you less in the end.

There are over 70,000 user of Cameron Pumps.

Write for a Copy of Bulletin No. 7104

A. S. Cameron Steam Pump Works, 11 Broadway, New York

OFFICES THE WORLD OVER



"Compressed Air"

BY WIGHTMAN

A glance at these headings shows how "Compressed Air" covers important points thoroughly

Production of Compressed Air

General Definitions—Physical Properties of Air—Composition of Air—Boyle's Law of Gases—Isothermal Compression—Charles' Law of Gases—Phenomena of Compression—Necessity for Cooling During Compression—Heating Effect of Compression—Loss of Work Due to Heat of Compression.

Compressed Air Indicator Card (Very Thorough)

Computing the I. H. P. of the Air Cylinder—Computing the Mechanical Efficiency of a Compressor— Determining the Volumetric Efficiency of a Compressor—Indicator Cards from Multi-Stage Compressors—Some Representative Indicator Cards.

Power Required to Compress Air

Horse-Power Developed in Compressing one Cubic Foot of Free Air from Atmospheric Pressure (14.7 lb.) to various gauge pressures (In Table Form)—Air Compression at Altitudes—Unavoidable Losses in Air Compression.

Classification of Compressor Types

Belt-Driven, Rope-Driven, Chain-Driven, Gear-Driven and Direct Shaft Connected (with motor or water wheel)—Vertical Compressors and Horizontal Compressors—Straight-Line Compressor—Duplex Compressor — Single-Stage Compression, etc.—Steam-Driven Compressors—Distinction between Steam-Engine and Compressor Practice—Compound Steam Cylinders on Air-Compressors—Steam Pressure for Compounding—Regulation of Steam-Driven Compressors.

Air-Compressor Valves (Fully Illustrated)

Mechanically Actuated Valves—Poppet and Automatic Valves—Air-Inlet Valves—Air-Discharge Valves—Areas of Valves, Ports and Passages—Inlet and Discharge Port Areas.

Ignitions and Explosions

Danger of Too Much Oil in Cylinders, etc.

A prominent engineer saved $800 the first six months of running his air compressors after using hints contained in this book.

Another writes: "It is gratifying to know just what losses I was having in my plant—I know, now, thanks to 'Compressed Air'—it's a good book."

"Compressed Air" is straight to the point and practically written by Lucius I. Wightman. It contains 165 pages, fully illustrated, and 15 tables. Bound in cloth—printed on coated paper with large readable type.

Given Free for Securing 3 New Subscriptions

POWER PLANT ENGINEERING, 537 South Dearborn Street, Chicago

COUPLINGS, UNION.
Cresson-Morris Co., New York.
Dart Mfg. Co., E. M., Providence, R. I.
Jefferson Union Co., Lexington, Mass.
Mark Mfg. Co., Evanston, Ill.
Rhode Island Fittings Co., Hills-Grove, R. I.
Rockwood Sprinkler Co. of Mass., Worcester, Mass.

CRANES, TRAVELING.
Link-Belt Co., Chicago.
Yale & Towne Mfg. Co., New York.

DIE STOCKS.
Armstrong Mfg. Co., Bridgeport, Conn.
Crane Co., Chicago.
Curtis & Curtis Co., Bridgeport, Conn.
Mark Mfg. Co., Evanston, Ill.

DRAFT, BALANCED.
Engineer Co., The, New York.

DRAWING INSTRUMENTS.
Starrett Co., L. S., Athol, Mass.

DRILLS, ELECTRIC.
Chicago Pneumatic Tool Co., Chicago. "Duntley."

DUST COLLECTORS.
Buffalo Forge Co., Buffalo.
Ohio Blower Co., Cleveland.

DYNAMOS AND MOTORS.
Allis-Chalmers Manufacturing Company, Milwaukee.
Engberg's Elec. & Mech. Works, St. Joseph, Mich.
General Electric Co., Schenectady, N. Y.
Manistee Iron Wks., Manistee, Mich.
Ridgway Dynamo & Engine Co., Ridgeway, Pa.
Sprague Electric Works, New York.
Westinghouse Electric & Mfg. Co., Pittsburgh.

EJECTORS.
Hayden & Derby Mfg. Co., New York.
Penberthy Injector Co., Detroit. "X-L—96."

ELECTRICAL MACHINERY AND SUPPLIES.
Allis-Chalmers Manufacturing Company, Milwaukee.
Chicago Pneumatic Tool Co., Chicago.
Economy Fuse & Mfg. Co., Chicago.
General Electric Co., Schenectady, N. Y.
Ridgeway Dynamo & Eng. Co., Ridgway, Pa.
Westinghouse Electric & Mfg. Co., Pittsburgh.

ELEVATORS.
Otis Elevator Co., New York.

ENGINE HOISTS.
Nordberg Mfg. Co., Milwaukee.

ENGINE REPAIRS.
Baker Valve Co., Minneapolis.
Lammert & Mann Co., Chicago.
Underwood & Co., H. B., Philadelphia.

ENGINES, GAS AND GASOLINE.
Allis-Chalmers Manufacturing Company, Milwaukee.
American Well Works, The, Aurora, Ill.

ENGINES, OIL.
Allis-Chalmers Manufacturing Company, Milwaukee.
Chicago Pneumatic Tool Co., Chicago.

ENGINES, STEAM.
Allis-Chalmers Manufacturing Company, Milwaukee.
American Well Works, The, Aurora, Ill.
Ball Engine Co., Erie, Pa.
Bates Machine Co., Joliet, Ill.
Engberg's Elec. & Mech. Wks., St. Joseph, Mich.
Erie City Iron Wks., Erie, Pa.
Griscom-Russell Co., New York.
Hooven, Owens, Rentschler Co., Hamilton, O. "Hamilton-Corliss."
Ide & Sons, A. L., Springfield, Ill.
Nordberg Mfg. Co., Milwaukee.
Northern Equipment Co., Erie, Pa.
Ridgway Engine Co., Erie, Pa.
Skinner Engine Co., Erie, Pa.
Vilter Mfg. Co., The, Milwaukee.
Westinghouse Machine Co., Pittsburgh.
Worthington Pump & Machy. Corp., New York.

ENGINE STOPS, AUTOMATIC.
Consolidated Engine Stop Co., Inc., New York.
Falls Machine Co., Sheboygan Falls, Wis.

EVAPORATORS.
Griscom-Russell Co., New York.

EXHAUST HEADS.
Direct Separator Co., Syracuse, N. Y.
Hoppes Mfg. Co., Springfield, O.
Ohio Blower Co., Cleveland.
Robertson & Sons, Jas. L., New York.
Sims Co., The, Erie, Pa.

EXHAUST PIPE HEADS.
Patterson-Kelly Co., The, New York.

EXTRACTORS, OIL AND GREASE.
Griscom-Russell Co., New York.
Lagonda Mfg. Co., Springfield, Ohio.
Sims Co., The, Erie, Pa.

FANS, ELECTRIC.
Buffalo Forge Co., Buffalo.
General Electric Co., Schenectady, N. Y.
Sprague Electric Works, New York.
Westinghouse Electric & Mfg. Co., Pittsburgh.
Wing Mfg. Co., L. J., New York.

FANS, EXHAUST AND VENTILATING.
Anderson Eng'r'g & Equip. Co., Anderson Co., V. D., Cleveland.
Coppus Eng'r'g & Equip. Co., Worcester, Mass.
Ohio Blower Co., Cleveland.
Sprague Electric Works, New York.
Wing Mfg. Co., L. J., New York.

FEED-WATER CONTROLLERS.
Chaplin-Fulton Mfg. Co., Pittsburgh. "Vigilant."
Northern Equipment Co., Erie, Pa.
Squires Co., The C. E., Cleveland.
S-C Regulator Co., Fostoria, O.
Williams Gauge Co., Pittsburgh.
Wing Mfg. Co., L. J., New York.

FEED-WATER FILTERS.
Elliott Company, Pittsburgh.
Griscom-Russell Co., New York.
Lagonda Mfg. Co., Springfield, Ohio.
Scaife & Sons Co., Wm. B., Pittsburgh.

FEED-WATER HEATERS AND PURIFIERS.
Bates Machine Co., Joliet, Ill. "Cookson."
Elliott Company, Pittsburgh. "Pittsburgh."
Griscom-Russell Co., New York.
Harrison Safety Boiler Works, Philadelphia.
Hoppes Mfg. Co., Springfield, O.
Kieley & Mueller, Inc., New York, N. Y.
National Pipe Bending Co., New Haven, Conn.
Paterson-Kelly Co., The, New York.
Robertson & Sons, Jas. L., New York.
Sims Co., The, Erie, Pa.
Scaife & Sons Co., Wm. B., Pittsburgh.
Springfield Boiler Mfg. Co., Springfield, Ill.
Wheeler Cond. & Eng'r'g Co., Carteret, N. J.

FILTERS, WATER.
Ross Valve Mfg. Co., Troy, N. Y.
Scaife & Sons Co., Wm. B., Pittsburgh.

FILTERS, OIL.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Elliott Company, Pittsburgh.
Robertson & Sons, Jas. L., New York.
Robertson Co., Jno. F., Pittsburgh.
Sims Co., The, Erie, Pa.

FIRE BRICK.
Betson Plastic Fire Brick Co., Rome, N. Y.
Harbison-Walker Refractories Co., Pittsburgh.
Jointless Fire Brick Co., Chicago.
McLeod & Henry Co., Troy, N. Y.
Quigley Furnace Specialties Co., New York.

FITTINGS, AMMONIA.
American Steam Gauge & Valve Mfg. Co., Boston.
Carbondale Machine Co., The, Carbondale, Pa.
Crane Co., Chicago.
Vilter Mfg. Co., Milwaukee.

FITTINGS, FLANGE AND PIPE.
American District Steam Co., No. Tonawanda, N. Y.
Crane Co., Chicago.
Direct Separator Co., Syracuse, N. Y.
Jefferson Union Co., Lexington, Mass.
Rhode Island Fittings Co., Worcester, Mass.
Rockwood Sprinkler Co., Worcester, Mass.
Williams Valve Co., D. T., Cincinnati.

FLANGES, CAST AND MALLEABLE.
Crane Co., Chicago.
Direct Separator Co., Syracuse, N. Y.
Fisher Governor Co., Marshalltown, Ia.

FLOOR STANDS.
Link-Belt Company, Chicago.
Lunkenheimer Co., The, Cincinnati.
Nelson Valve Co., Philadelphia.

FLOATS.
Anderson Co., The V. D., Cleveland.
Reliance Gauge Column Co., Cleveland.

FLOW METERS.
Spray Eng'r'g Co., Boston.

FLUE CLEANERS.
Bayer Steam Soot Blower Co., St. Louis.
Diamond Power Specialty Co., Detroit.
Huyette Co., The Paul B., Philadelphia.
Lagonda Mfg. Co., Springfield, Ohio.
Liberty Mfg. Co., Pittsburgh.
Paxson Co., J. W., Philadelphia.
Pilley Pkg. & Flue Brush Mfg. Co., St. Louis.
Roto Company, Hartford, Conn.
Stephenson Mfg. Co., Albany.

FURNACES.
Combustion Eng'r'g Corp., New York.
Green Engineering Co., Chicago.
Hofft Co., M. A., Indianapolis.
McClave-Brooks Co., Scranton,
Nelson Blower & Furnace Co., Boston.

To Find the Manufacturers' Advertisements of Products Listed Here, See Index Page 68

FUSES.
Daum, A. F., Pittsburgh.
Economy Fuse & Mfg. Co., Chicago. "Economy."
Johns-Manville Co., H. W., New York.

GAS ANALYSIS INSTRUMENTS.
Defender Auto. Regulator Co., St. Louis, Mo.

GASKETS.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Goodrich Co., The B. F., Akron.
Graton & Knight Mfg. Co., Worcester, Mass.
Jenkins Bros., New York. "96."
Johns-Manville Co., H. W., New York.
New York Belting & Packing Co., New York.
Peerless Rubber Mfg. Co., New York.
Quaker City Rubber Co., Philadelphia. "Ebonite," "Skihi" and "Hercules."
Smooth-On Mfg. Co., Jersey City.

GAS PRODUCERS.
Nelson Blower & Furnace Co., Boston.
Westinghouse Machine Co., Pittsburgh.

GAUGES, DIFFERENTIAL.
Ashton Valve Co., Boston.
Defender Auto. Regulator Co., St. Louis, Mo.
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn.

GAUGES, DRAFT.
Defender Auto. Regulator Co., St. Louis, Mo.
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn.
Taylor Instrument Cos., Rochester, N. Y.

GAUGES, PRESSURE.
American Steam Gauge & Valve Mfg. Co., Boston.
American Well Works, The, Aurora, Ill.
Ashton Valve Co., Boston.
Crosby Steam Gauge & Valve Co., Boston.
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn.
Taylor Instrument Cos., Rochester, N. Y.
Williams Valve Co., D. T., Cincinnati.

GAUGES, RECORDING.
American Steam Gauge & Valve Mfg. Co., Boston.
Ashton Valve Co., Boston.
Crosby Steam Gauge & Valve Co., Boston.
Defender Auto. Regulator Co., St. Louis, Mo.
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn.
Williams Valve Co., D. T., Cincinnati.

GAUGES, WATER.
American Injector Co., Detroit.
Foxboro Co., The, Foxboro, Mass.
Huyette Co., The Paul B., Philadelphia.
Jenkins Bros., New York. "Braber."
Lunkenheimer Co., The, Cincinnati.
Marion Mach., Fdry. & Supply Co., Marion, Ind.
Michigan Lubricator Co., Detroit.
Ohio Brass Co., The, Mansfield, Ohio. "Ohio Brass."
Penberthy Injector Co., Detroit.
Powell Co., Wm., Cincinnati.
Reliance Gauge Column Co., Cleveland.
Williams Valve Co., D. T., Cincinnati.

GAUGES, WATER LEVEL RECORDING.
Foxboro Co., The, Foxboro, Mass.

GAUGE COCKS.
American Injector Co., Detroit.
Huyette Co., The Paul B., Philadelphia.
Jenkins Bros., New York.
Lunkenheimer Co., The, Cincinnati.
Michigan Lubricator Co., Detroit.
Nason Mfg. Co., New York. "Aetna."
Ohio Brass Co., The, Mansfield, Ohio. "Ohio Brass."
Penberthy Injector Co., Detroit.
Powell Co., Wm., Cincinnati.
Reliance Gauge Column Co., Cleveland.
Robertson Co., Jno. F., Pittsburgh.
S-C Regulator Co., Fostoria, O.
Williams Valve Co., D. T., Cincinnati.

GAUGE GLASSES.
Advance Pkg. & Supply Co., Chicago.
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Michigan Lubricator Co., Detroit.
New York Belting & Packing Co., New York.
Peerless Rubber Mfg. Co., New York.
Quaker City Rubber Co., Philadelphia.

GAUGE TESTERS.
American Steam Gauge & Valve Mfg. Co., Boston.
Ashton Valve Co., Boston.
Fisher Governor Co., Marshalltown, Ia.

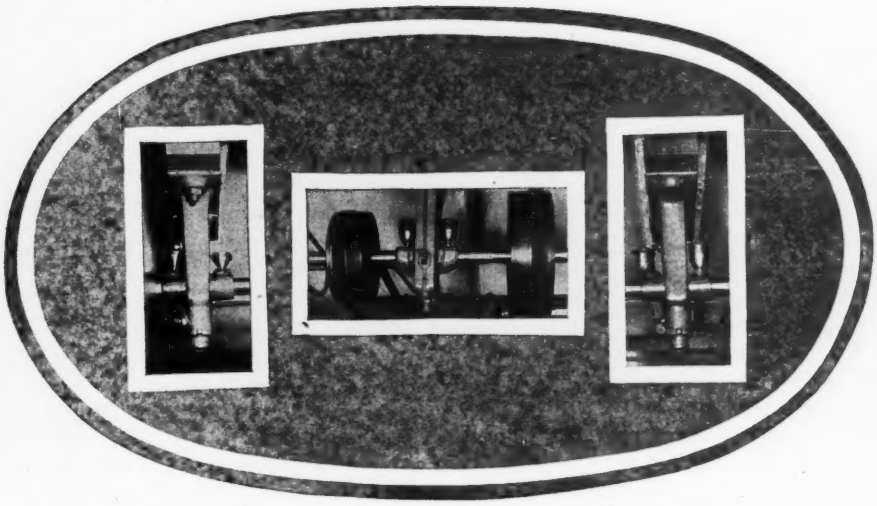
GENERATING SETS.
Allis-Chalmers Manufacturing Company, Milwaukee.
Buffalo Forge Co., Buffalo.
Engberg's Elec. & Mech. Wks., St. Joseph, Mich.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Electric Wks., New York.
Westinghouse Electric & Mfg. Co., Pittsburgh.

GOVERNORS, PUMP.
Chaplin-Fulton Mfg. Co., Pittsburgh. "Fulton."
Crane Co., Chicago.
Dean Bros. Steam Pump Wks., Indianapolis.
Defender Auto. Regulator Co., St. Louis, Mo.
d'Este Co., Julian, Boston.
Fisher Governor Co., Newark.
Foster Engineering Co., Newark.
Gardner Governor Co., Quincy, Ill.
Kieley & Mueller Inc., New York, N. Y.
Northern Equipment Co., Erie, Pa.
Mason Regulator Co., Boston.
S-C Regulator Co., Fostoria, O.
Squires Co., The C. E., Cleveland.
Williams Gauge Co., Pittsburgh.

GRAPHITE.
Dixon Crucible Co., Jos., Jersey City. "Ticonderoga."

GRAPHITE PRODUCTS.
Bound Brook Oil-less Bearing Co., Bound Brook, N. J.
Dixon Crucible Co., Jos., Jersey City. "Ticonderoga."

GRAPHITED GREASE.
Dixon Crucible Co., Jos., Jersey City.



The Albany Way is the Right Way to Lubricate Line Shafting

To use Albany Grease on line shafting, no expensive equipment is necessary. Just a simple matter of placing in the oil hole on the shaft hanger a spindle grease cup filled with Albany Grease. You will eliminate drip pans, oil gutters and the service of oilers, interrupted work, loss and accidents to men climbing about moving machinery, ruined goods, oil-soaked floors, walls and ceilings; in fact, remove a hundred and one things that increase fire risk, loss of valuable stock, labor, and reduce the cost of lubrication.

ALBANY GREASE

can be used in any kind or style of grease cup. We have records of cups holding from 2 to 5 ounces of Albany Grease on line shafting in daily operation, running from 10 to 18 months without refilling or attention. We'll gladly send, without charge or expense to you, a quantity of Albany Grease and an Albany Cup for you to try on your line shafting or any other bearing in your plant. **Why not write us—now?**

Your Dealer Sells Albany Grease, if not, order direct

ALBANY LUBRICATING CO.

ADAM COOK'S SONS, Props.

708-10 Washington St. New York

Established 1868

GRATE BARS.
Flynn & Emrich Co., Baltimore.

GRATES, CHAIN.
Armstrong Mfg. Co., Springfield, Ohio.
Green Engineering Co., East Chicago, Ind.

GRATES.
Armstrong Mfg. Co., Springfield, Ohio.
Combustion Eng'r'g Corp., New York.
Flynn & Emrich Co., Baltimore.
Green Engineering Co., East Chicago, Ind.
Hofft Co., M. A., Indianapolis.
Kelly Foundry & Mach. Works, Goshen, Ind.
Marion Mach. Fdry. & Supply Co., Marion, Ind.
McClave Brooks Co., Scranton, Pa.

GREASE.
Albany Lubricating Co., New York. "Albany."
Cook's Sons, Adam, New York. "Albany."
Dixon Crucible Co., Jos., Jersey City.
Keystone Lubricating Co., Philadelphia.
N. Y. & N. J. Lubricant Co., New York.
Ohio Grease Co., The, Loudonville, Ohio.
Swan & Finch Co., New York.
Texas Co., New York.

GREASE CUPS.
(See Oil and Grease Cups.)

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HANGERS.
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Link-Belt Co., Chicago.

HOISTS.
Ingersoll-Rand Co., New York.
Link-Belt Co., Chicago.
Otis Elevator Co., New York.
Sprague Electric Works, New York.
Yale & Towne Mfg. Co., New York.

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American Metal Hose Co., Waterbury, Conn.
Goodrich Co., The B. F., Akron, Ohio.
New York Belting & Packing Co., New York. "Perfected."
Peerless Rubber Mfg. Co., New York.
Quaker City Rubber Co., Philadelphia.

HOSE, METAL.
American Metal Hose Co., Waterbury, Conn.
Johns-Manville Co., H. W., New York, N. Y.
Sprague Electric Works, New York.

HYGRODIEKS.
Taylor Instrument Cos., Rochester, N. Y.

HYGROMETERS.
Taylor Instrument Cos., Rochester, N. Y.

ICE MACHINE REPAIRS.
Underwood & Co., H. B., Philadelphia.

ICE MAKING AND REFRIGERATING MACHINERY.
Carbondale Machine Co., The, Carbondale, Pa.
Vilter Mfg. Co., Milwaukee.

INDICATORS, ENGINE.
Ashcroft Mfg. Co., New York.
Crosby Steam Gauge & Valve Co., Boston.
Robertson & Sons, James L., New York. "Robertson-Thompson."
Schaeffer & Budenberg Mfg. Co., Brooklyn.
Trill Indicator Co., Corry, Pa. "Trill." "Triumph."

INDICATORS, SPEED.
American Steam Gauge & Valve Mfg. Co., Boston.
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn.
Starrett Co., L. S., Athol, Mass.

INJECTORS AND INSPIRATORS.
American Injector Co., Detroit.
Hayden & Derby Mfg. Co., New York.
Jenkins Bros., New York. "Sellers."
Lunkenheimer Co., Cincinnati.
Penberthy Injector Co., Detroit.
Powell Co., The Wm., Cincinnati.

INSTRUMENTS, MATHEMATICAL.
Starrett Co., L. S., Athol, Mass.

INSULATING MATERIAL.
Johns-Manville Co., H. W., New York.
Keasbey & Mattison Co., Ambler, Pa.
Magnesia Assn. of America, New York.

INSULATION.
Johns-Manville Co., H. W., New York.
Keasbey & Mattison Co., Ambler, Pa.
Magnesia Assn. of America, New York.

JOINTS, EXPANSION.
Crane Co., Chicago.
Griscom-Russell Co., New York.

LAMPGUARDS.
Flexible Steel Lacing Co., Chicago, Ill.

LAMPS, ELECTRIC.
General Electric Co., Schenectady, N. Y.
National Lamp Wks., Cleveland.
Westinghouse Co., East Pittsburgh.
Westinghouse Lamp Co., New York.

LAMPS, INCANDESCENT.
General Electric Co., Schenectady, N. Y.
National Lamp Wks., Cleveland.
Westinghouse Electric & Mfg. Co., Pittsburgh.
Westinghouse Lamp Co., New York.

LEAD, BLACK.
Dixon Crucible Co., Jos., Jersey City.

LIGHTING SYSTEMS.
General Electric Co., Schenectady, N. Y.
National Lamp Wks., Cleveland.
Westinghouse Electric & Mfg. Co., Pittsburgh.
Westinghouse Lamp Co., New York.

LINK BELT.
Link-Belt Co., Chicago.

LOCOMOTIVE CRANES.
Link-Belt Co., Chicago.

LUBRICANTS.
Albany Lubricating Co., New York.
Cook's Sons, Adam, New York. "Albany Grease."
Dearborn Chemical Co., Chicago.
Dixon Crucible Co., Jos., Jersey City.
Keystone Lubricating Co., Philadelphia.
N. Y. & N. J. Lubricant Co., New York.
Ohio Grease Co., Loudonville, O.
Standard Oil Co., Chicago.
Steel Mill Packing Co., Detroit.
Swan & Finch Co., New York.
Texas Co., New York.

LUBRICATING GRAPHITE.
Dixon Crucible Co., Jos., Jersey City.

LUBRICATING OIL CABINETS.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.

LUBRICATORS.
Albany Lubricating Co., New York.
American Injector Co., Detroit.
American Well Works Co., The, Aurora, Ill.
Bound Brook Oil-less Bearing Co., Bound Brook, N. J.
Cook's Sons, Adam, New York.
Crosby Steam Gauge & Valve Co., Boston, Mass.
Green, Tweed & Co., New York. "Rochester."
Keystone Lubricating Co., Philadelphia, Pa.
Manzel Bros. Co., Buffalo.
Michigan Lubricator Co., Detroit. "Michigan Cyclone."
Ohio Grease Co., Loudonville, O.
Powell Co., The Wm., Cincinnati.
Stephenson Mfg. Co., Albany.
Williams Valve Co., D. T., Cincinnati.

LUBRICATORS, FORCE FEED.
Greene, Tweed & Co., New York. "Rochester."
Lunkenheimer Co., The, Cincinnati.
Manzel Bros. Co., Buffalo.
McCord Mfg. Co., Detroit.

MAGNESIA PRODUCTS.
Keasbey & Mattison Co., Ambler, Pa.
Magnesia Assn. of America, New York.

MECHANICAL DRAFT APPARATUS.
Buffalo Forge Co., Buffalo.
Coppus Eng'r'g & Equip. Co., Worcester, Mass.
Nelson Blower & Furnace Co., Boston.
Wing Mfg. Co., L. J., New York.

NOZZLES FOR ALL PURPOSES.
Spray Eng'r'g Co., Boston.

OIL.
Albany Lubricating Co., New York. "Albany."
Cooks' Sons, Adam, New York. "Albany."
N. Y. & N. J. Lubricant Co., New York.
Standard Oil Co., Chicago.
Swan & Finch Co., New York.
Texas Co., New York.

OIL AND GREASE CUPS.
Albany Lubricating Co., New York. "Albany."
American Injector Co., Detroit.
Cook's Sons, Adam, New York. "Albany."
Keystone Lubricating Co., Philadelphia.
Lunkenheimer Co., Cincinnati.
Michigan Lubricator Co., Detroit.
Ohio Grease Co., The, Loudonville, O.
Penberthy Injector Co., Detroit.
Powell Co., The Wm., Cincinnati.
Standard Oil Co., Chicago.
Williams Valve Co., D. T., Cincinnati.

OIL COOLERS.
Sims Co., The, Erie, Pa.

OIL TANKS.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Elliott Company, Pittsburgh.
Manzel Bros. Co., Buffalo.
Scaife & Sons Co., Wm. B., Pittsburgh.

OILING SYSTEMS.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Elliott Company, Pittsburgh.
Federal Metallic Packing Co., Boston.
Goetze Gasket & Packing Co., New Brunswick, N. J.

To Find the Manufacturers' Advertisements of Products Listed Here, See Index Page 68

PACKINGS, METALLIC.
Crane Packing Co., Chicago. "John Crane."
Holmes Metallic Packing Co., Wilkes-Barre, Pa.
Federal Metallic Packing Co., Boston.
Steel Mill Packing Co., Detroit. "Safety."

PACKING, PISTON AND ROD.
Bowers Rubber Works, San Francisco. "Skookum."
Crane Packing Co., Chicago. "John Crane."
Eureka Packing Co., New York.
Federal Metallic Packing Co., Boston.
Goodrich Co., The B. F., Akron, Ohio.
Greene, Tweed & Co., New York.
Johns-Manville Co., H. W., New York.
New York Belting & Packing Co., New York. "Cobbs," "Vulcan," "Turxo."
New York Belting & Packing Co., New York. "Rainbow," "Eclipse."
Pilley Pkg. & Flue Brush Mfg. Co., St. Louis.
Quaker City Rubber Co., Philadelphia. "P. P. P."
Steel Mill Packing Co., Detroit.
Vanda Co., The, New York.

PACKINGS, SHEET.
Advance Pkg. & Supply Co., Chicago.
Eureka Packing Co., New York.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Goodrich Co., The B. F., Akron, Ohio.
Graton & Knight Mfg. Co., Worcester, Mass.
Jenkins Bros., New York. Jenkins "96." "Jenarco."
Johns-Manville Co., H. W., New York.
Johns-Manville Co., H. W., New York.
Powell Co., The Wm., Cincinnati.
New York Belting & Packing Co., New York. "Indestructible."
Peerless Rubber Mfg. Co., New York. "Rainbow." "Eclipse."
Pilley Pkg. & Flue Brush Mfg. Co., St. Louis.
Powell Co., The Wm., Cincinnati.
Quaker City Rubber Co., Philadelphia. "Ebonite."
Robertson & Sons, Jas. L., New York. "Eureka."
Vanda Co., The, New York.

PACKING, VALVE STEM.
Crane Packing Co., Chicago. "John Crane."
Goetze Gasket & Packing Co., New Brunswick, N. J.
Greene, Tweed & Co., New York.
Johns-Manville Co., H. W., New York.
New York Belting & Packing Co., New York.
Quaker City Rubber Co., Philadelphia. "Valvolite."
Steel Mill Packing Co., Detroit.

PIPE BENDING.
National Pipe Bending Co., New Haven, Conn.

PIPE CLAMPS.
Yarnall-Waring Co., Philadelphia.

PIPE COVERINGS.
Johns-Manville Co., H. W., New York.
Keasbey & Mattison Co., Ambler, Pa.
Magnesia Assn. of America, New York.

PIPE COILS.
National Pipe Bending Co., New Haven, Conn.

PIPE CUTTERS.
Armstrong Mfg. Co., Bridgeport, Conn.
Curtis & Curtis Co., Bridgeport, Conn. "Forbes."
Mark Mfg. Co., Evanston, Ill.
Trimont Mfg. Co., Roxbury, Mass.

PIPE LINE MEASURES, SELF-LUBRICATING.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.

PIPE THREADING MACHINES.
Armstrong Mfg. Co., Bridgeport, Conn.
Crane Co., Chicago.
Curtis & Curtis Co., Bridgeport, Conn.
Mark Mfg. Co., Evanston, Ill.
Trimont Mfg. Co., Roxbury, Mass.

PIPE FOR COILS.
National Tube Co., Pittsburgh.

PIPE, WOOD.
American District Steam Co., No. Tonawanda, N. Y. "Standard."

PIPE, WROUGHT.
Mark Mfg. Co., Evanston, Ill.
National Tube Co., Pittsburgh.

PIPING.
Mark Mfg. Co., Evanston, Ill.
National Tube Co., Pittsburgh.

PLANIMETERS.
Ashton Valve Co., Boston.
Foxboro Co., The, Foxboro, Mass.
Robertson & Son, Jas. L., New York. "Willis."
Schaeffer & Budenburg Mfg. Co., Brooklyn.

PLUMBAGO.
Dixon Crucible Co., Jos., Jersey City.

PORTABLE TOOLS.
Chicago Pneumatic Tool Co., Chicago.

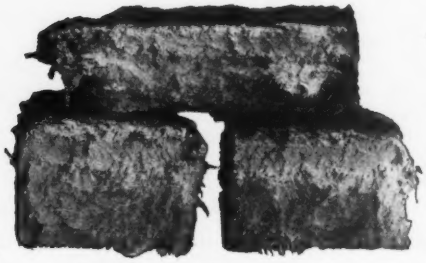
POWER HOUSE CONVEYORS.
Link-Belt Company, Chicago.

POWER PLANT APPLIANCES.
Magnesia Assn. of America, New York.

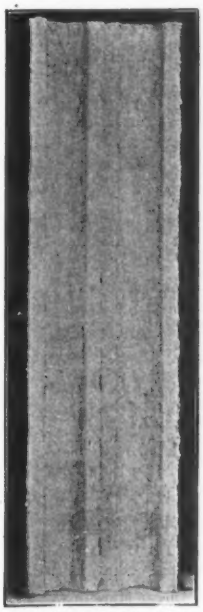
POWER TRANSMISSION.
American Steel & Wire Co., Chicago-New York.
Cresson-Morris Co., Philadelphia.
Goodrich Co., The B. F., Akron, Ohio.
Graton & Knight Mfg. Co., Worcester, Mass.
Johns-Manville Co., H. W., New York.
Link-Belt Company, Chicago.
New York Belting & Packing Co., New York.
Otis Elevator Co., New York.
Peerless Rubber Co., New York.
Quaker City Rubber Co., Philadelphia.
Schieren Co., Chas. A., New York.

SECTION—(outside) after Sixteen years.

All of these samples of "85% Magnesia" are as serviceable as when new



BLOCKS of "85% Magnesia" after Fifteen years' Superheat Service.



SECTION—(inside) after Sixteen years.

"Temporarily removed" after sixteen years of service

The *section* of "85% Magnesia" shown above is back again on the job.

It was removed because the steam-pipes needed replacement, and the "85% Magnesia" coverings which protected the old pipe were again used upon the new one. So you see, the pipes may wear out, but the Magnesia—Never!

The *blocks* above shown are still in perfect condition after fifteen years of continuous superheat service at an average temperature of 400 degrees.

These and even more severe conditions do not affect "85% Magnesia" coverings—it is what they are made for.

But because some engineers may not fully appreciate their wonderful durability we are reproducing these pictures of them.

This is only part of the interesting story of "85% Magnesia" told in the new Handbook on Heat-Insulation, "Let '85% Magnesia' Defend Your Steam." Sent on request.

Also, on request, we send a full scientific Specification for the application of "85% Magnesia" coverings to every kind of steam service.

"85% MAGNESIA"

The Universal Covering for Pipes and Boilers

MAGNESIA ASSOCIATION OF AMERICA, 702 BULLETIN BLDG., PHILADELPHIA, PA.

(The member companies of this Association are contractors to the U. S. Army and Navy and to munition plants.)

EXECUTIVE COMMITTEE

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J. R. Swift, The Franklin Mfg. Co., Franklin, Pa.
R. V. Mattison, Jr., Keasbey & Mattison Co., Ambler, Pa.

PRESSURE REGULATORS.
Crane Co., Chicago.
Dean Bros. Steam Pump Wks., Indianapolis.
d'Este Co., Julian, Boston. "Curtis."
Defender Auto. Regulator Co., St. Louis, Mo.
Elliott Company, Pittsburgh.
Fisher Governor Co., Marshalltown, Ia.
Foster Engineering Co., Newark.
Mason Regulator Co., Boston.
Ohio Brass Co., The, Mansfield, Ohio. "Ohio Brass."
Robertson & Son, Jas. L., New York.
Squires Co., The C. E., Cleveland.
Taylor Instrument Cos., Rochester, N. Y.

PULLEYS.
American Well Works, The, Aurora, Ill.
Cresson-Morris Co., Philadelphia.
Link-Belt Company, Chicago.

PULLEYS, FRICTION CLUTCH.
American Well Works, The, Aurora, Ill.
Link-Belt Company, Chicago.

PULLEYS, STEEL.
Cresson-Morris Co., Philadelphia.

PUMPING ENGINES, WATER WORKS.
American Well Works, The, Aurora, Ill.
American Steam Pump Co., Battle Creek, Mich.
Gardner Governor Co., Quincy, Ill.
Nordberg Mfg. Co., Milwaukee.
Worthington Pump & Machy. Corp., New York.

PUMP LEATHERS.
Graton & Knight Mfg. Co., Worcester, Mass.
Mark Mfg. Co., Evanston, Ill.

PUMPS.
Allis-Chalmers Manufacturing Company, Milwaukee.
American Steam Pump Co., Battle Creek, Mich. "Marsh" and "American."
American Well Works, The, Aurora, Ill.
Buffalo Steam Pump Co., Buffalo.
Cameron Steam Pump Works, A. S., New York.
Dean Bros. Steam Pump Works, Indianapolis.
Deming Co., The, Salem, Ohio.
Gardner Governor Co., Quincy,
Ingersoll-Rand Co., New York.
Lammert & Mann Co., Chicago.
Manistee Iron Wks., Manistee, Mich.
Northern Equipment Co., Erie.
Wheeler Con. & Eng'r'g Co., Carteret, N. J.
Worthington Pump & Machy. Corp., New York.

PUMPS, BOILER FEED.
Allis-Chalmers Manufacturing Company, Milwaukee.
American Steam Pump Co., Battle Creek, Mich. "Marsh" and "American."
American Well Works, The, Aurora, Ill.
Cameron Steam Pump Works, A. S., New York.
Dean Bros. Steam Pump Wks., Indianapolis, Ind.
Erie Pump & Equip. Co., Erie.
Gardner Governor Co., Quincy,
Manistee Iron Wks., Manistee, Mich.

PUMPS, CENTRIFUGAL.
Allis-Chalmers Manufacturing Company, Milwaukee.
American Steam Pump Co., Battle Creek, Mich.
American Well Works, The, Aurora, Ill.
Buffalo Steam Pump Co., Buffalo.
Cameron Steam Pump Works, A. S., New York.
Lammert & Mann Co., Chicago.
Manistee Iron Wks., Manistee, Mich.
Northern Equipment Co., Erie.
Plant Eng'r'g & Equip. Co., New York.
Wheeler Cond. & Eng'r'g Co., Carteret, N. J.
Worthington Pump & Machy. Corp., New York.

PUMPS, CONDENSER.
American Steam Pump Co., Battle Creek, Mich.
Dean Bros. Steam Pump Wks., Indianapolis, Ind.
Manistee Iron Wks., Manistee, Mich.
Wheeler Cond. & Eng'r'g Co., Carteret, N. J.

PUMPS, COMPOUND.
American Steam Pump Co., Battle Creek, Mich. "American."
Cameron Steam Pump Works, A. S., New York.
Dean Bros. Steam Pump Wks., Indianapolis.
Gardner Governor Co., Quincy,

PUMPS, DEEP WELL.
American Steam Pump Co., Battle Creek, Mich. "Marsh."
American Well Works, The, Aurora, Ill.
Cameron Steam Pump Works, A. S., New York.
Deming Co., The, Salem, Ohio.
Northern Equipment Co., Erie.

PUMPS, ELECTRIC.
American Steam Pump Co., Battle Creek, Mich.
Buffalo Steam Pump Co., Buffalo.
Cameron Steam Pump Works, A. S., New York.
Dean Bros. Steam Pump Wks., Indianapolis.
Gardner Governor Co., Quincy, Ill.

PUMPS, ELEVATOR AND FIRE.
American Steam Pump Co., Battle Creek, Mich. "American."
Cameron Steam Pump Works, A. S., New York.
Dean Bros. Steam Pump Wks., Indianapolis.
Gardner Governor Co., Quincy, Ill.
Manistee Iron Wks., Manistee, Mich.

PUMPS, HYDRAULIC PRESSURE
American Steam Pump Co., Battle Creek, Mich. "Marsh."
American Well Works, The, Aurora, Ill.
Buffalo Steam Pump Co., Buffalo.
Dean Bros. Steam Pump Works, Indianapolis.
Worthington Pump & Machy. Corp., New York.

PUMPS, JET.
American Well Works, The, Aurora, Ill.
Cameron Steam Pump Works, A. S., New York.
Manistee Iron Wks., Manistee, Mich.

PUMPS, MINE.
American Steam Pump Co., Battle Creek, Mich.
Manistee Iron Wks., Manistee, Mich.

PUMPS, OIL.
American Injector Co., Detroit.
American Steam Pump Co., Battle Creek, Mich.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Buffalo Steam Pump Co., Buffalo.
Lunkenheimer Co., Cincinnati.
Manzel Bros., Buffalo.
Penberthy Injector Co., Detroit.
Powell Co., The Wm., Cincinnati.
Williams Gauge Co., Pittsburgh.
Williams Valve Co., D. T., Cincinnati.

PUMPS, POWER.
American Steam Pump Co., Battle Creek, Mich.
Buffalo Steam Pump Co, Buffalo.
Gardner Governor Co., Quincy, Ill.
Worthington Pump & Machy. Corp., New York.

PUMPS, PLUNGER.
American Steam Pump Co., Battle Creek, Mich. "Marsh" and "American."
American Well Works, The, Aurora, Ill.
Cameron Steam Pump Works, A. S., New York.
Dean Bros. Steam Pump Works, Indianapolis.
Gardner Governor Co., Quincy, Ill.

PUMPS, ROTARY.
Lammert & Mann Co., Chicago.
Manistee Iron Wks., Manistee, Mich.
Plant Eng'r'g & Equip Co., New York.

PUMPS, SELF-MEASURING.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.

PUMPS, SINKING.
American Steam Pump Co., Battle Creek, Mich. "Marsh."
American Well Works, The, Aurora, Ill.
Cameron Steam Pump Works, A. S., New York.
Dean Bros. Steam Pump Works, Indianapolis.
Manistee Iron Wks., Manistee, Mich.

PUMPS, STEAM.
American Steam Pump Co., Battle Creek, Mich. "Marsh" and "American."
American Well Works, The, Aurora, Ill.
Buffalo Steam Pump Co., Buffalo.
Cameron Steam Pump Works, A. S., New York.
Dean Bros. Steam Pump Works, Indianapolis.
Gardner Governor Co., Quincy, Ill.
Manistee Iron Wks., Manistee, Mich.
Worthington Pump & Machy. Corp., New York.

PUMPS, TILTING HOT WATER.
Nashua Machine Co., Nashua, N. H.

PUMPS, TURBINE.
Buffalo Steam Pump Co., Buffalo.
Cameron Steam Pump Works, A. S., New York.
Plant Eng'r'g & Equip. Co., New York.
Worthington Pump & Machy. Corp., New York.

PUMPS, VACUUM.
American Steam Pump Co., Battle Creek, Mich. "Marsh."
Buffalo Steam Pump Co., Buffalo.
Caemron Steam Pump Works, A. S., New York.
Dean Bros. Steam Pump Works, Indianapolis.
Gardner Governor Co., Quincy.
Lammert & Mann Co., Chicago.
Manistee Iron Wks., Manistee, Mich.
Plant Eng'r'g & Equip. Co., New York.
Wheeler Cond. & Eng'r'g Co., Carteret, N. J.
Worthington Pump & Machy. Corp., New York.

PUMPS, WATERWORKS.
American Steam Pump Co., Battle Creek, Mich.
Manistee Iron Wks., Manistee, Mich.

PURIFIERS.
Harrison Safety Boiler Works, Philadelphia.
Hoppes Mfg. Co., Springfield, O.
Sims Co., The, Erie, Pa.

PURIFIERS, BOILER FEED.
Scaife & Sons Co., Wm. B., Pittsburgh.

PURIFIERS, OIL.
Robertson Co., Jno. F., Pittsburgh.

PYROMETERS.
American Steam Gauge & Valve Mfg. Co., Boston.
Denfender Auto. Regulator Co., St. Louis, Mo.
Foxboro Co., The, Foxboro, Mass.

To Find the Manufacturers' Advertisements of Products Listed Here, See Index Page 68

Schaeffer & Budenberg Mfg. Co., Brooklyn.
Taylor Instrument Cos., Rochester, N. Y.

RECORDING INSTRUMENTS.
Crosby Steam Gauge & Valve Co., Boston.
Defender Auto. Regulator Co., St. Louis, Mo.
Foxboro Co., The, Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn.
Taylor Instrument Cos., Rochester, N. Y.

REDUCING WHEELS.
Ashton Valve Co., Boston.
Robertson & Sons, Jas. L., New York. "Victor."

REGULATORS, DAMPER.
Defender Auto. Regulator Co., St. Louis, Mo.
d'Este Co., Julian, Boston. "Curtis."
Engineer Co., The, New York.
Kieley & Mueller, Inc., New York.
Mason Regulator Co., Boston.
Sarco Company, Inc., New York.
Wing Mfg. Co., L. J., New York.

REGULATORS, FEED WATER.
Chaplin-Fulton Mfg. Co., Pittsburgh, Pa. "Vigilant."
Defender Auto. Regulator Co., St. Louis, Mo.
Elliott Co., Pittsburgh. "Liberty."
Foster Engineering Co., Newark.
Lagonda Mfg. Co., Springfield, O.
Northern Equipment Co., Erie, Pa.
S-C Regulator Co., Fostoria, Pa.
Squires Co., The C. E., Cleveland.
Williams Gauge Co., Pittsburgh.
Wing Mfg. Co., L. J., New York.

REGULATORS, PUMP.
d'Este Co., Julian, Boston.
Defender Auto. Regulator Co., St. Louis, Mo.

REGULATORS, TEMPERATURE.
d'Este Co., Julian, Boston.
Sarco Co., Inc., New York.
Taylor Instrument Cos., Rochester, N. Y.

RESEATING MACHINES, BOILER, CAP AND HEADER.
Lagonda Mfg. Co., Springfield Ohio.

RESEATING MACHINES.
Lagonda Mfg. Co., Springfield, Ohio.
Leavitt Machine Co., Orange, Mass.
Quaker City Rubber Co., Philadelphia.

RETURN TRAPS.
d'Este Co., Julian, Boston. "Curtis."
Nashua Machine Co., Nashua, N. H. "Bundy."

RIVETS.
Crescent Belt Fastener Co., New York.

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Plant Eng'r'g & Equip. Co., New York.
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Anderson Co., The V. D., Cleveland. "Improved."
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Elliott Company, Pittsburgh.
Jenkins Bros., New York. "Diamond."
Johns-Manville Co., H. W., New York.
Kieley & Mueller, Inc., New York.
Nashua Machine Co., Nashua, N. H. "Bundy."
Nason Mfg. Co., New York. "Sidelug."
Patterson-Kelly Co., The New York.
Plant Eng'r'g & Equip. Co., New York.
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Squire Co., The C. E., Cleveland.
Williams Gauge Co., Pittsburgh.
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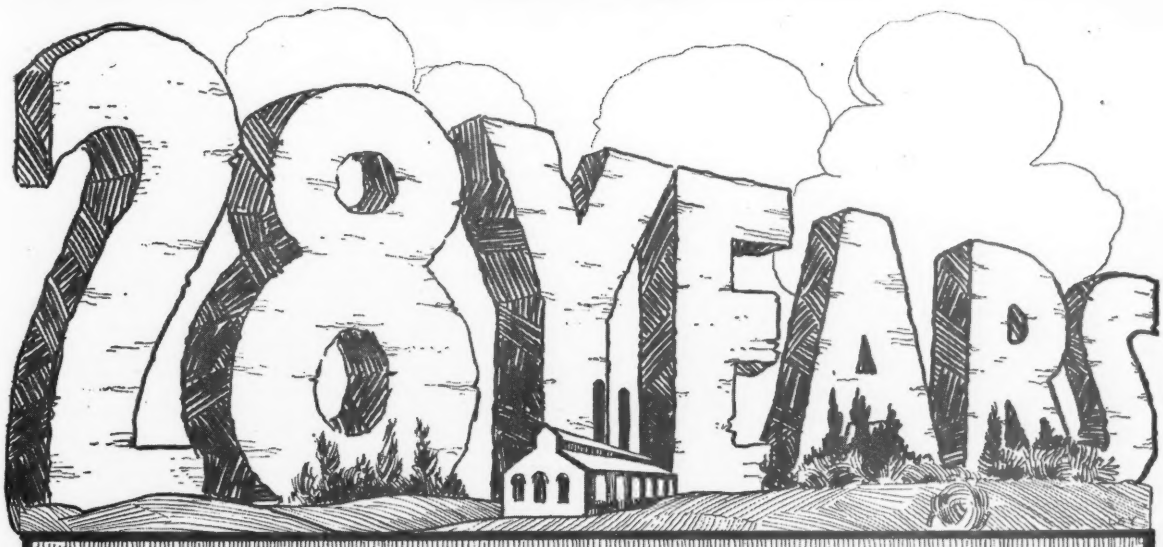

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d'Este Co., Julian, Boston. "Curtis."
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Foster Engineering Co., Newark.
Harrison Safety Boiler Works, Philadelphia.
Homestead Valve Mfg. Co., Pittsburgh.
Jenkins Bros., New York.

To Find the Manufacturers' Advertisements of Products Listed Here, See Index Page 68

Lagonda Mfg. Co., Springfield, Ohio.
Lunkenheimer Co., The, Cincinnati. "Duro."
Mason Regulator Co., Boston.
Nelson Valve Co., Philadelphia.
Northern Equipment Co., Erie.
Ohio Brass Co., The, Mansfield, Ohio. "Ohio Brass."
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Quaker City Rubber Co., Philadelphia.

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Powell Co., Wm., Cincinnati.
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Lunkenheimer Co., Cincinnati.
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Nelson Valve Co., Philadelphia.

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Chapman Valve Mfg. Co., The, Indian Orchard, Mass.

VALVES, CAST IRON AND CAST STEEL.
Cadman Mfg. Co., A. W., Pittsburgh.
Chapman Valve Mfg. Co., The, Indian Orchard, Mass.

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VALVES, DIAPHRAGM.
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Mason Regulator Co., Boston.

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Williams Valve Co., D. T., Cincinnati.

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Royal Mfg. Co., Rahway, N. J.

WASTE, WOOL.
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Powell Co., Wm., Cincinnati.
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Plant Eng'r'g & Equip Co., New York.
Worthington Pump & Machinery Corp., New York.
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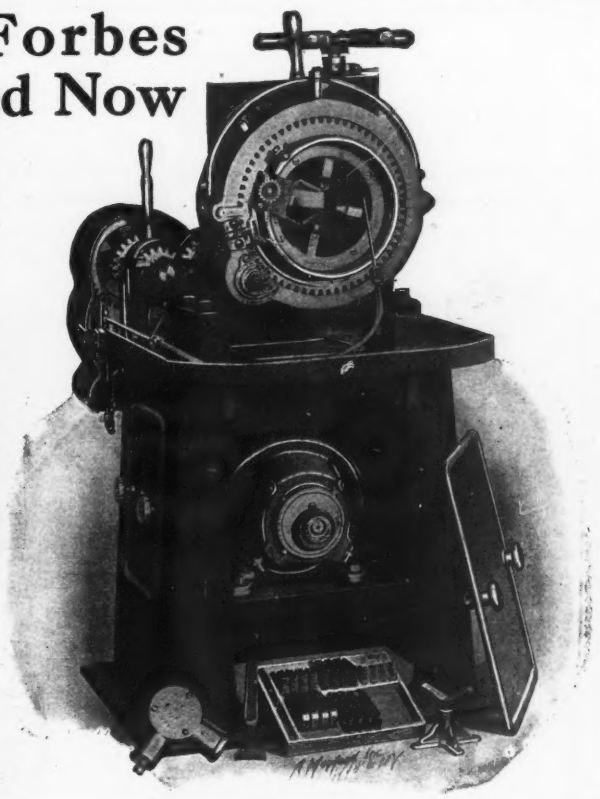

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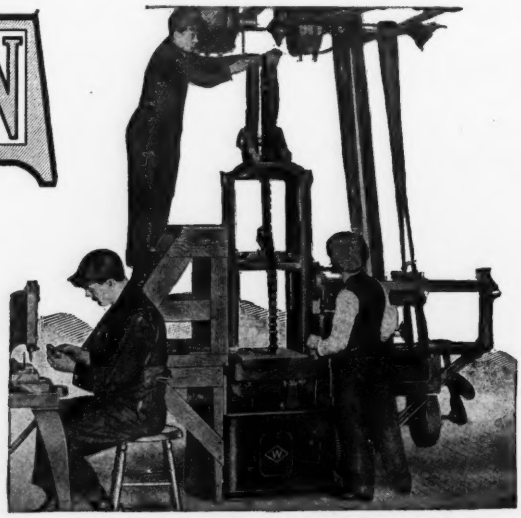

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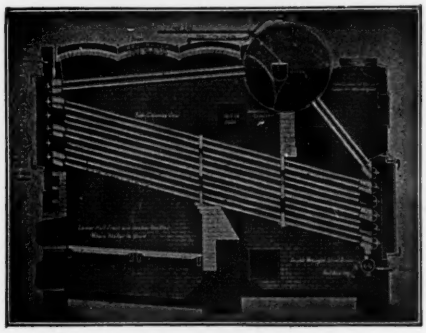

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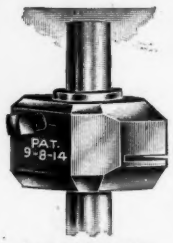

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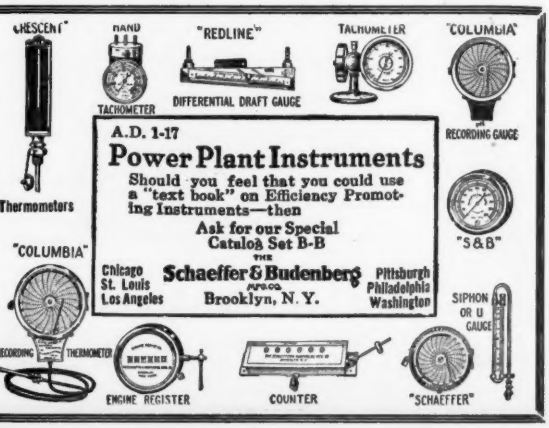

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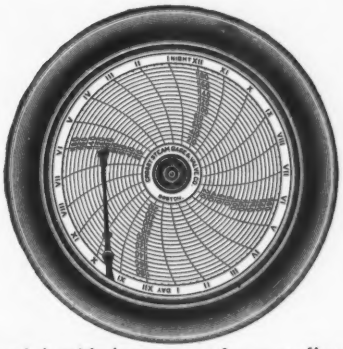

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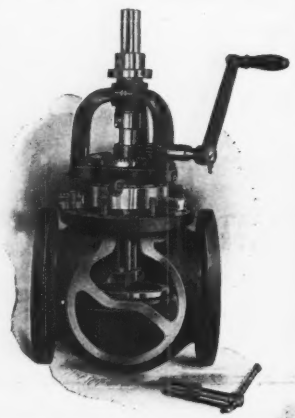

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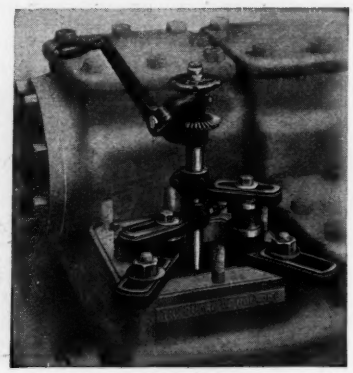

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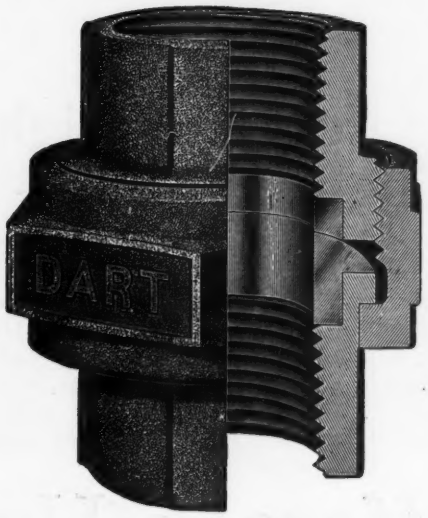
42-741

LOOK



Look for the name DART on the nut. That's the sure way to know the Dart Union—the anti-trouble Union with the Bronze to Bronze Seats—the Union that doesn't corrode or leak. Write for sample (free) and test it.

It will pay you well to do your pipe union buying in a deliberate, thoughtful sort of way. It will pay you to investigate carefully—to make some actual working tests—for while a single union is a comparatively small and inexpensive thing, the unions you use in a year constitute a large item, to say nothing of the cost of putting them in. Of course you cannot make complete investigations or tests without including

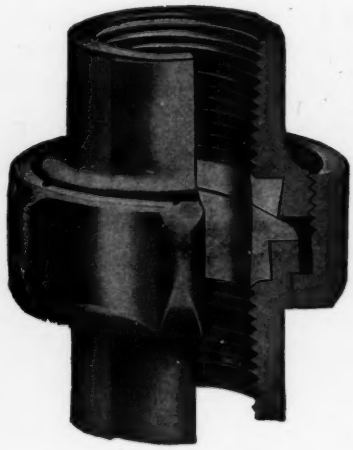
DART UNIONS

so we offer to send you a Dart Union for trial absolutely free, or we'll send you any number of them you may require on approval, just so you can learn the truth about Dart Unions. When you do get to know them, you'll save a tremendous amount of trouble with leaky joints and a lot of money. Start something. Write now.

E. M. Dart Manufacturing Co., The Fairbanks Company, Sales Agents **Providence, R. I.**

Canadian Factory, Dart Union Company, Ltd., Toronto

The Rockwood Union Is The Trouble-Less Union



—and there's a good reason why. Its design and construction keep it out of the class of trouble-makers. It is pressed steel with bronze seats, practically welded into the pressed steel and ground to a ball joint. It will hold tight under 1000 pounds pressure—passes this test before shipment. Carefully consider its other points of advantage and you will want nothing else but the Rockwood Union.

Expands and contracts equally with the pipe.

Has a unique nut—easily applied or loosened.

Sherardized after threading—therefore rustproof and corrosion-proof.

These are all mighty important points to look into, but we want to send you full description. Write us NOW.

Rockwood Sprinkler Company of Mass.

Worcester ∴ ∴ ∴ ∴ ∴ **Massachusetts**

They Light the

The Safety Car Lighting and Heating Company—
another Jersey Plant "Jeffersonized"

Scores of Jersey City concerns have learned that it pays to pay for a superior pipe union—and that standardizing with that superior pipe union means real efficiency in the transmission of steam in their plants.

Among those who have equipped thoroughly with

Jefferson Unions

—the superior unions—is The Safety Car Ltg. and Htg. Co.

The construction of the Jefferson—which you can see in the sectional view—appealed to them as most decidedly practical. It's ball joint is ground, insuring a permanently tight joint no matter how many times it is set up or taken down.

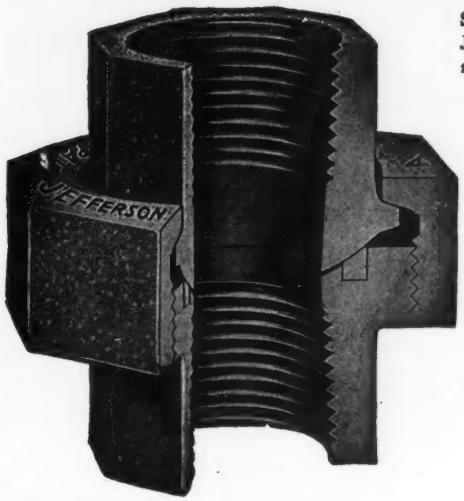
Its brass to iron seat—the seat ring set back from the runway—insuring a corrosionless joint that stays put.

Its heavy construction and a dozen other superior features—these are the things that appealed to this concern as they have to thousands of others who value tight pipe connections throughout their plants.

If you're not well acquainted with Jeffersons you had better let us send the "Union" book. It's free for the asking.

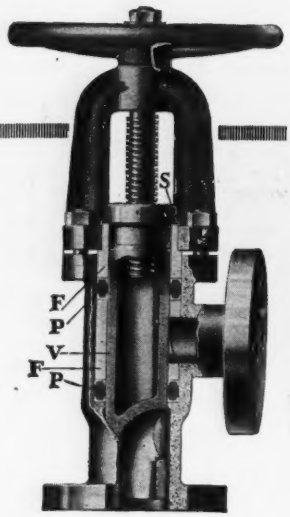
Jefferson Union Company
Lexington, Mass.

Pullman Cars-



Safety Car Ltg. and Htg. Co., of Jersey City — *Manufacturers of railway car lighting equipment.*

Did you ever have a blow-off valve that lasted 6 years without leaking?



COULD you say the same thing about your blow-off valves that this man says about the Simplex?

He states, in part—

"used six years . . . twice daily . . . tight now . . . never leaked . . . repacked once, four years after being installed . . . best valve on the market."

And such records are not at all unusual.

In fact some of the first Simplex "Seatless" Blow-Off Valves manufactured eight years ago are still in use, and doing good work.

When you are familiar with Simplex construction, you will readily understand why it continues to give reliable service for so many years.

Note particularly, in the diagram shown here, the absence of seats and discs, and the protected position of the packing.

Operation

In closing valve, shoulder S on plunger V engaged the loose follower gland F, compressing packing P above and below the port, making an absolutely tight valve.

SIMPLEX SEATLESS "NO SEAT TO LEAK" BLOW-OFF VALVE

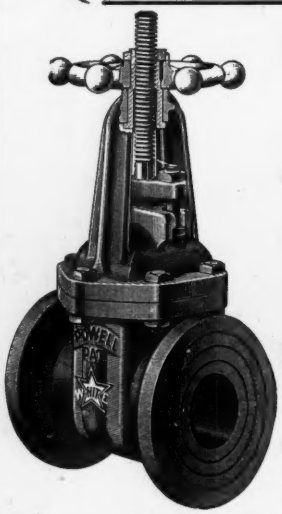
You can try a Simplex on one of your boilers for 60 days, returning it to us at the end of that time if not entirely satisfactory.

Write today, stating size of line, and whether flanged or screwed, angle or straightaway.

YARNALL-WARING CO.
Penna. R. R. & Mermaid Lane
Chestnut Hill, Philadelphia

POWELL VALVES

(Especially The "White Star" Valve)



Gate Valves

Made in Sizes 2 inch to 16 inch

Screwed and Flanged Ends

Rising and Non-Rising Stems

Medium and Extra Heavy Patterns

Booklet on Request

Ask your dealer for "Powell" Valves—or write us

THE WM. POWELL CO.
DEPENDABLE ENGINEERING SPECIALTIES.
CINCINNATI, O.

This Should Be On Your Blowoff Line

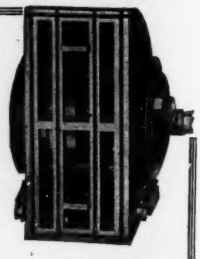
The Homestead Quarter Turn Valve combined with the Hovalco Valve is a positive safeguard on your blowoff line. The Homestead can be shut off while the Hovalco is being overhauled without sacrificing the production of power.

Our guarantee protects you, but once you install our valves you will not care to part with them. You will find them indispensable.

Write for our literature and learn more about this safety and economy combination.

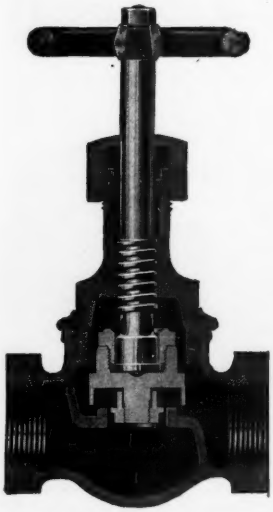
Homestead Valve Mfg. Co.
Homestead, Pa.

Speaking of Leaks



—you would stop one at a flange connection because you can **see** the loss. How about the frictien or leakage loss on your slide or piston valve engine?

You know it's there, so why not stop it? Write the Baker Valve Company, Box 1772, Dept. A, Minneapolis, Minn., and learn why a Vapor Tight Valve should save this expense.



Sectional view of "Ohio Brass" Standard J. D. Valve, 150-lb. working pressure.

Regularly furnished for steam service. Special discs supplied if specified for Gas, Water, etc.

"Ohio Brass" J. D. Valves Are Trustworthy

You can put an "Ohio Brass" J. D. Valve in the pipe line and be certain that it is strong and tight. Because that very valve has already proved its strength and tightness in a rigid factory test.

The O-B Composition Disc which is used in these Valves is extraordinary—it yields to make a tight seat, every time, and yet it is hard enough to resist abrasion.

"Quality First" is the rule which governs every process in the manufacture of "Ohio Brass" Valves. Long and satisfactory service follows naturally.

Buy "Ohio Brass" Valves from your Supply House.

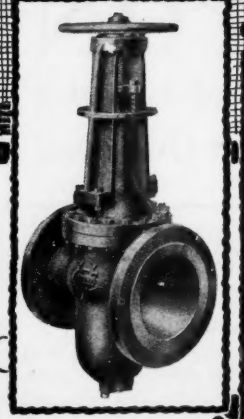
O-B Composition Disc

The "Ohio Brass" line includes Regulating Valves, Water Gauges and Gauge Cocks, J. D. Globes, Angles and Checks, Brass Disc Globes, Angles and Checks, Gate Valves, Steam and Hot Water Radiator Valves and Union Elbows.

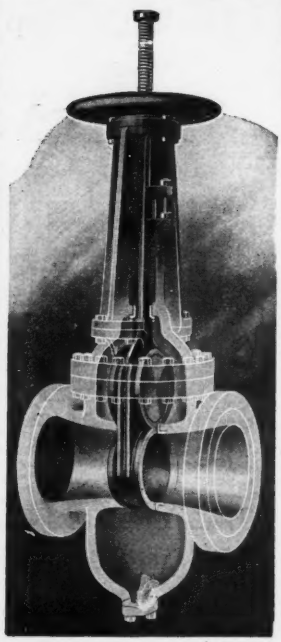
Look for the Trade (B) Mark

The Ohio Brass Co., Mansfield, Ohio

FULLY PROTECTED AT VITAL PARTS



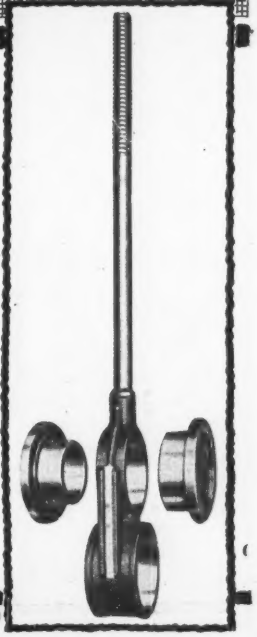
Send for Catalog 132



The internal and external construction of the CHAPMAN Valve is here shown. Note that valve is practically a continuation of pipe line, also that seats and discs are protected from action of steam when valve is open. The gates and seats are of Monel metal. There is no danger of parts becoming loose.

This Venturi type of valve is adapted for high pressure and superheated steam. This and many other valves are described in our illustrated catalog. May we send you one?

The Chapman Valve Mfg. Co.
Indian Orchard, Mass.



Pumping plant of Blackstone Hotel, Chicago, showing installation of Nelson Valves.

On the big pumps

—in the most talked of hotel in the United States, the Blackstone Hotel, Chicago.

The hotel that specializes on service demands service qualities in the equipment it installs. That is essential. It can give no better than it receives.

Especially is care required in the selection of all that goes into the fitting up of the power plant and the installation of the pumps.

In the Blackstone Hotel, Chicago, **NELSON VALVES** have been selected for both purposes.

You will find them in the small pipes, in the big, high pressure mains and in the numerous lines that range between these two.

And in the scores of places used, dependable daily service has been the result.

There are numerous reasons for **NELSON** reliability. They may be found at every stage of manufacture, from metallurgist's analysis to the final testing.

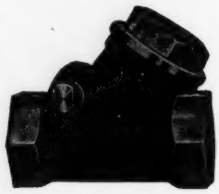
We shall be glad to explain them in detail upon request.

NELSON VALVE CO.
Penna. R. R. and
Mermaid Lane,
Chestnut Hill, Phila.

NELSON VALVES
"a safe valve investment"

Which Valve is the Best?

When ordering new valves, this question naturally comes to mind before any other. The next question that suggests itself is, "Which valve costs the least to maintain?" To both of these questions there can be but one answer—**Williams Valves** are **best** because they stand higher pressures and last longer than others. **Cost of maintenance** amounts to nothing, as they do not require extra discs or seats. If worn, they are easily and quickly reground with a little oil and emery. When finished, the valve is as good as new at no extra cost.



Williams Swing Check Valves

are excellent valves for use on boiler feed lines or any other place where the pressure must be controlled by a check valve. Heavy in construction, they have full unobstructed passage through body, which greatly reduces friction and necessarily prolongs the life of the valve. If you want higher valve efficiency at less cost—order Williams. They are strictly guaranteed for 200 pounds pressure.

Send us a postal for the New Williams Catalogue.

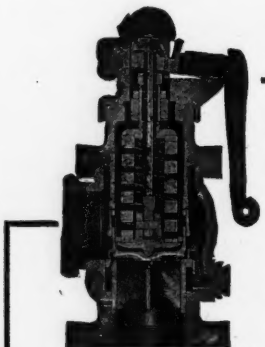
The D. T. Williams Valve Co.
Cincinnati, Ohio

Why Not Try An

ASHTON

Lock-Up Pop Safety Valve

at Our Risk?



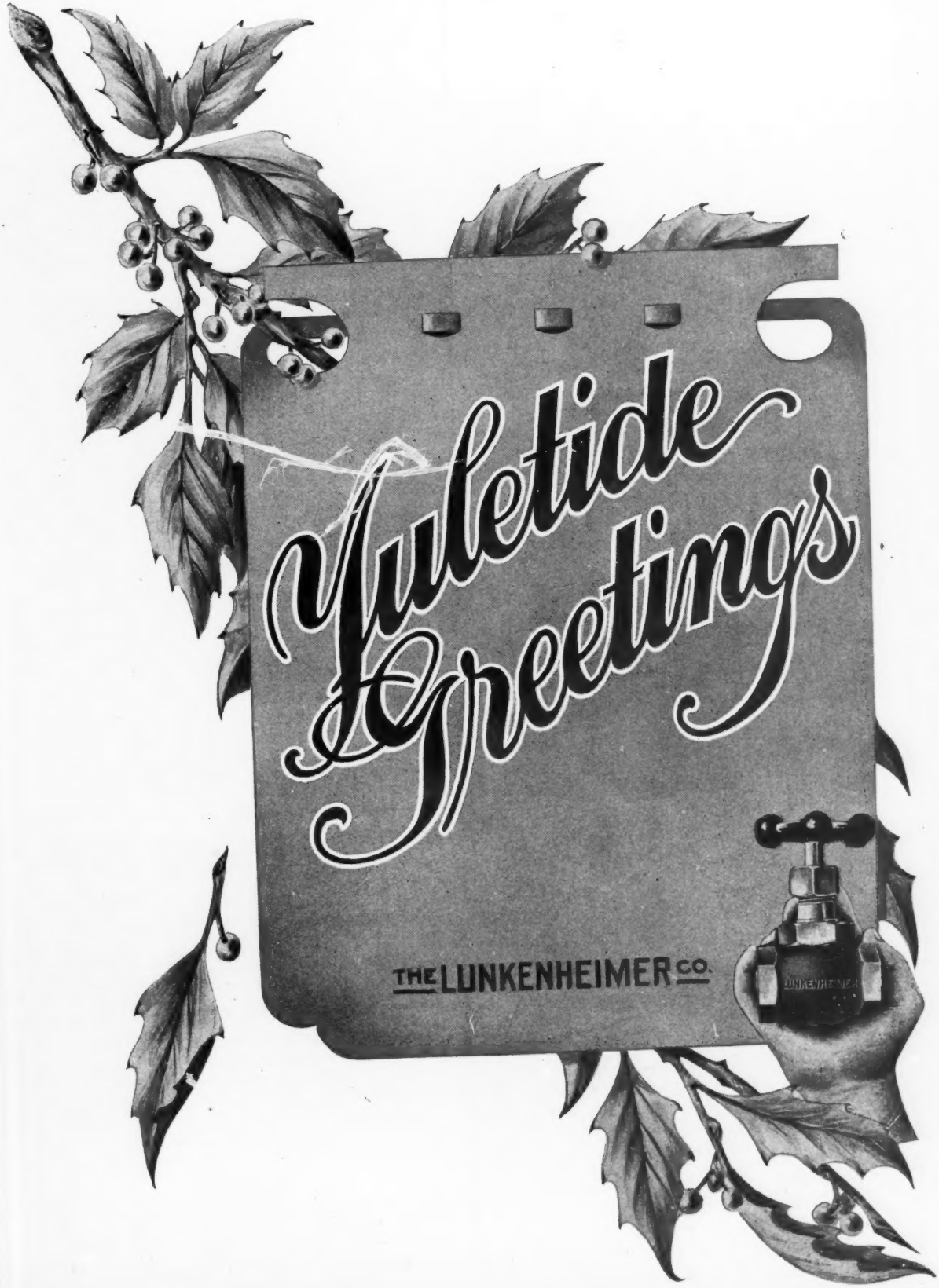
Why not see for yourself its splendid materials and workmanship, its ease of adjustment, its all-around betterness?

We'll send it to you ON APPROVAL, just to show you why you ought to use Ashton Valves throughout your plant—why YOU ought to be getting daily benefit from the Ashton third of a century experience in valve making. And if that valve does not show you, CONCLUSIVELY, it is your privilege to send it back.

By the way, you'll need a copy of our Catalogue. Where shall we send it?

THE ASHTON VALVE CO. 161 First St. Cambr.dge, Mass.

Branch Offices:
128 Liberty St., New York 174 N. Market St., Chicago


Yuletide Greetings
THE LUNKENHEIMER CO.
LUNKENHEIMER

It's Easy to Apply

The moment a belt slips the least bit, grab a stick of Stephenson Bar Belt Dressing and—in a jiffy—the trouble's over. You can dress a belt running at full speed—and there's no dirt or grease when the job's done.

Get a Stick—Free

and try it on your most troublesome belt. You'll find results very satisfactory. Send for your sample stick today and chuck your belt dressing troubles for good. You're not obligated in any way. Simply write us.

Stephenson Mfg. Co.
Albany, N. Y.

Engineers

Read the Inscription on the Barrel

Then get your pencil and figure the saving in using a boiler purge that weighs 105 pounds lighter to the 52-gallon barrel than any other compounds or boiler "dope" on the market.

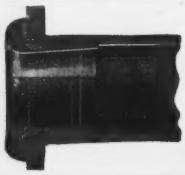
It's Caldera Purga and we have the courage of our conviction to say that it is the only boiler treatment you should use.

It eliminates scale in an absolutely harmless way, contains neither acids nor chemicals—never evaporates, burns out nor explodes—It is a natural wood product. It puts a thin film on the boiler metal which does not retard heat transmission.

It helps you generate steam with a small amount of energy and coal. Send for a trial half barrel.

We know that this will go farther and do better than any scale-remedy you have ever tried. Send the order NOW. Booklet on request.

The Caldera Purga Co.
(Incorporated)
Conway Building, Chicago, Illinois

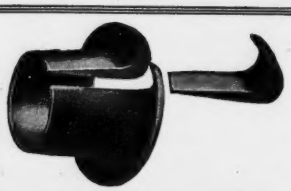


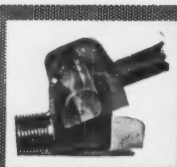
By Strengthening the Weakest Part

Cruise Boiler Tube Protectors

add years of service to your boilers. Their cost is but a trifle, they are easy to attach, and they afford a practically new set of tubes. Write for particulars.

Telephone 45-R and 526-R **CRUISE & COMPANY** 144-150 Broadway ELIZABETH, N. J.





THE GUARANTEED
CORLISS VALVE STEAM TRAP
PLANT ENGINEERING & EQUIPMENT COMPANY, 4 CHURCH ST., N.Y.
STUDY THE VALVE
POWER PLANT EQUIPMENT, PUMPS, AIR COMPRESSORS, ETC.

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What Would Happen

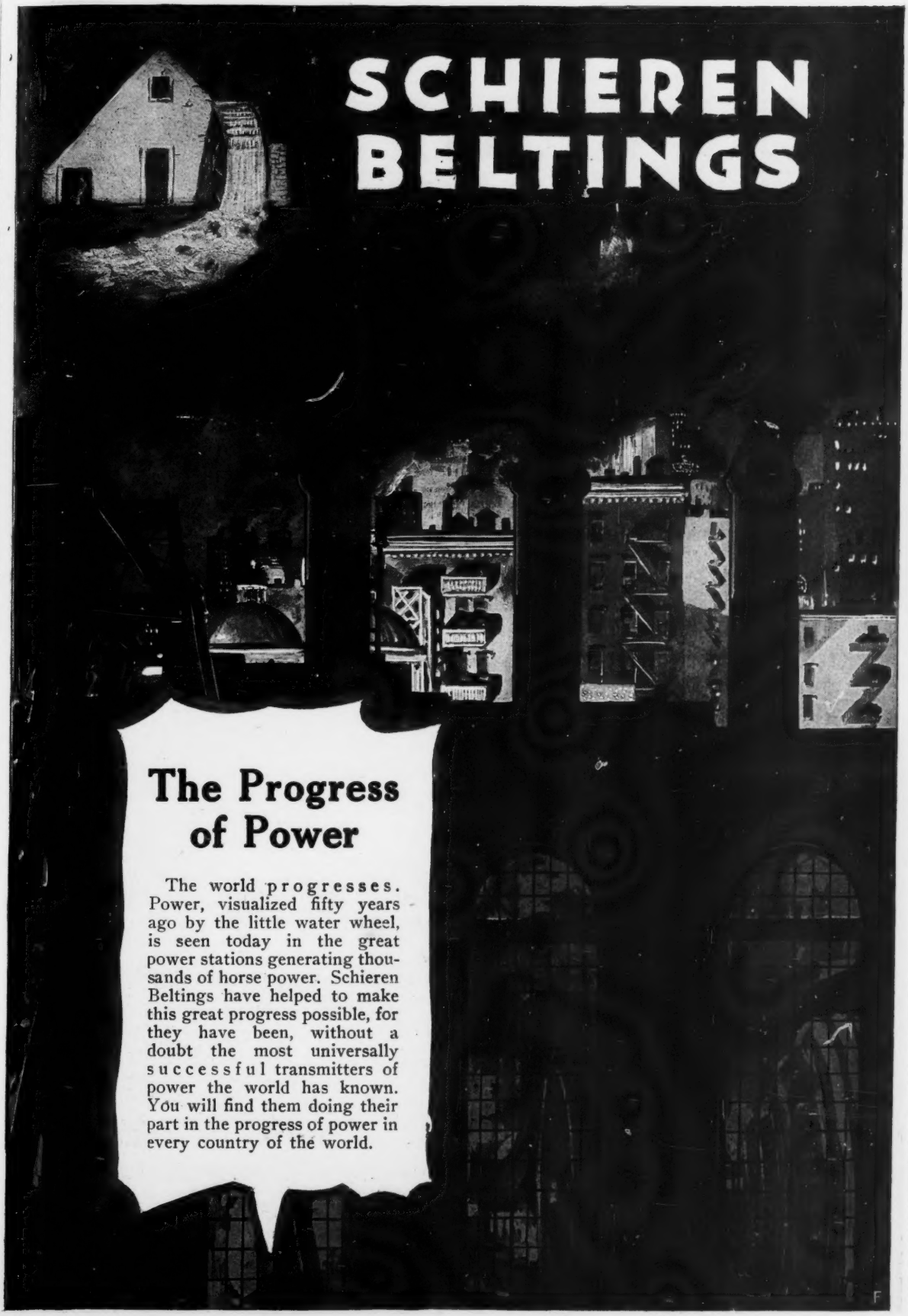
If your engine load were suddenly reduced by the breaking of your main driving belt or by the burning out of your armature? Any engineer will reply:—
"Your engine will race with the probability of a flywheel explosion."
In such an emergency the

Falls **Engine Stop**
will automatically and instantly shut off the steam.

Let Us Tell You Why

Falls Machine Co. Sheboygan Falls, Wis.

The Last Word in Safety and Dependability
in any emergency—is the
Consolidated Automatic Engine Stop
an absolutely safe device, which enables you to instantly cut off your steam supply—when the engines overspeed.
Operates without friction—actuated by gravity only.
Write today for full particulars.
Consolidated Engine Stop Co., 351 West 38th Street, New York


SCHIEREN
BELTINGS
The Progress of Power
The world progresses. Power, visualized fifty years ago by the little water wheel, is seen today in the great power stations generating thousands of horse power. Schieren Beltings have helped to make this great progress possible, for they have been, without a doubt the most universally successful transmitters of power the world has known. You will find them doing their part in the progress of power in every country of the world.

SCHIEREN Service

Assisting in the Solution of Belt Problems

If you had an automobile that wouldn't run properly, you would get an **automobile man** to find the trouble and remedy it.

When you are sick, a physician prescribes a cure.

The solution of the problem is placed in the hands of a **specialist** in either case.

Why don't you do the same on your belting problems?

The Chas. A. Schieren Company is now completing its 50th year in the leather belting business.

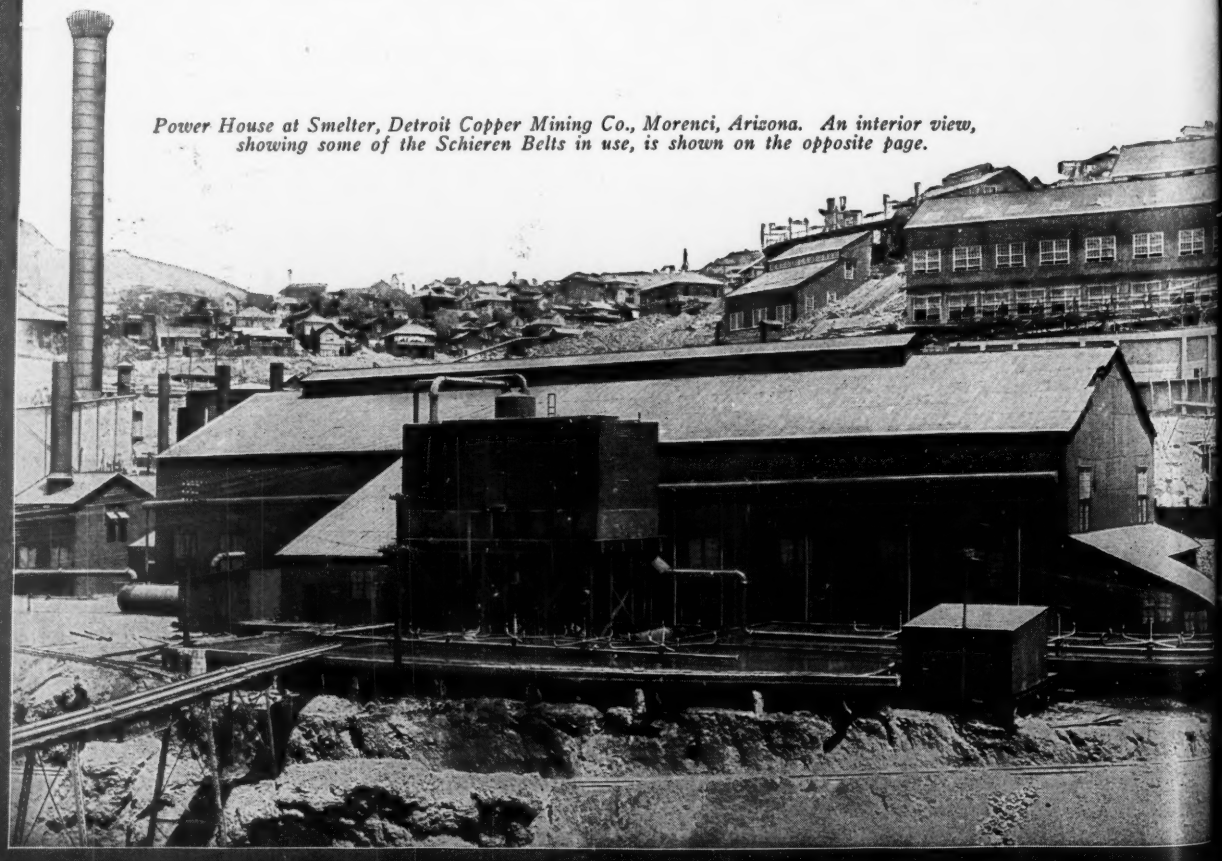
Don't you think that 50 years of specialization in this one busin ss has brought to our attention at some time or other all of the belt problems that you will ever have to face?

The manner of the solution of these problems for others has not been forgotten by us. Each individual problem is written large in our book of experience.

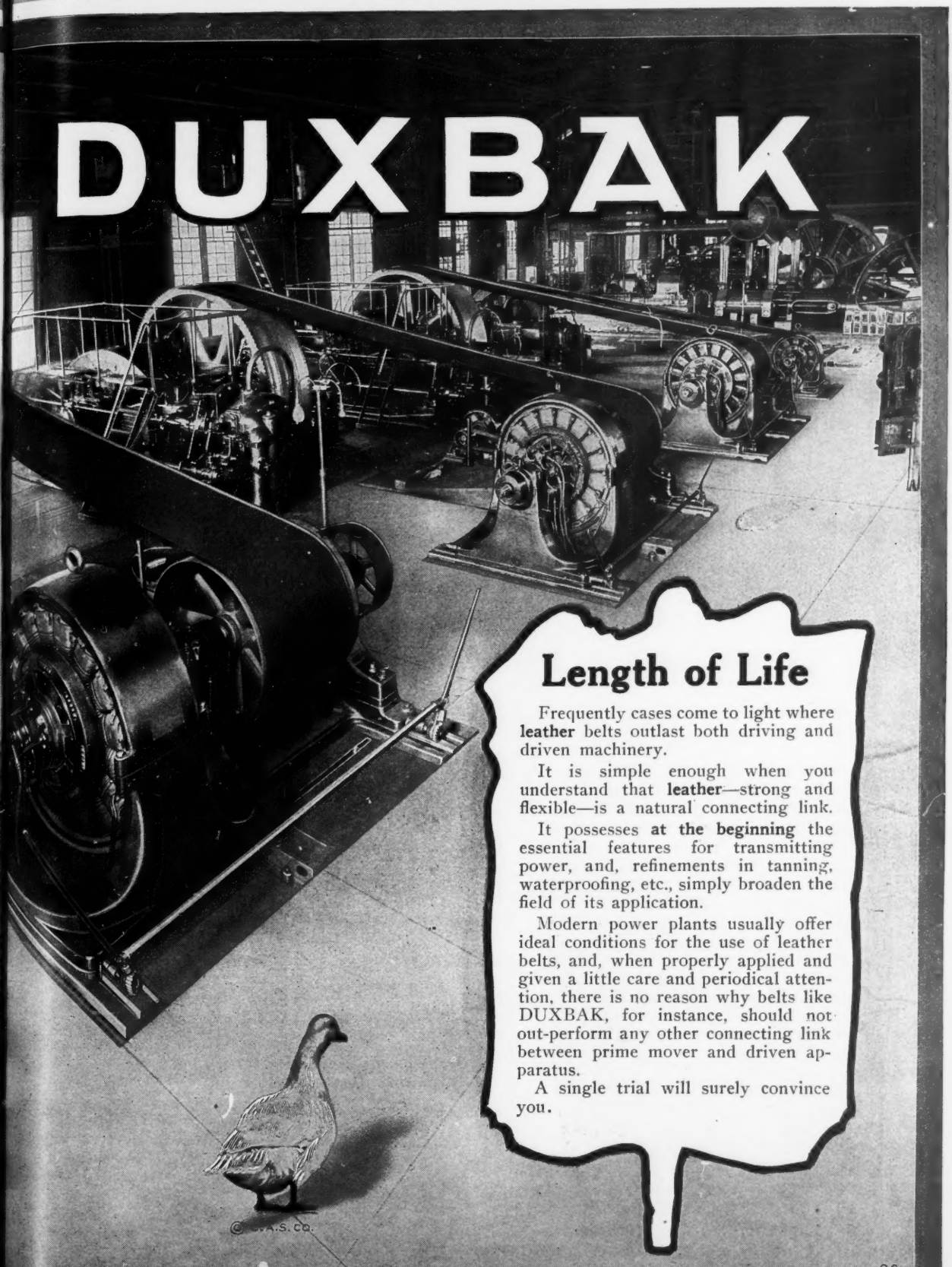
Leather belts successfully transmit power in every power-using industry. The field of their uses has been broadened largely by the **successful solution** of engineering problems by men who know what leather belting will do under any and all conditions.

When you want to consider leather belting for some special transmission, or if you have some drive which is not now operating satisfactorily, **consult with specialists in leather belting and its application.**

Power House at Smelter, Detroit Copper Mining Co., Morenci, Arizona. An interior view, showing some of the Schieren Belts in use, is shown on the opposite page.



DUXBAK



Length of Life

Frequently cases come to light where **leather** belts outlast both driving and driven machinery.

It is simple enough when you understand that **leather**—strong and flexible—is a natural connecting link.

It possesses **at the beginning** the essential features for transmitting power, and, refinements in tanning, waterproofing, etc., simply broaden the field of its application.

Modern power plants usually offer ideal conditions for the use of leather belts, and, when properly applied and given a little care and periodical attention, there is no reason why belts like DUXBAK, for instance, should not out-perform any other connecting link between prime mover and driven apparatus.

A single trial will surely convince you.

© U.A.S. CO.

20

Organized effort means efficient service

Without organized effort very little would be accomplished—no matter if referring to a college foot-ball team or to a large business organization. The Schieren Organization, 50 years in the moulding, is reflected in our many branches and dealers, maintained so that YOU may be given more efficient service. Write for information.

DUXBAK BELTING
TRADE MARK
Reg. U. S. Pat. Off.

Chas. A. Schieren Company
ESTABLISHED 1842

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Belt Manufacturers
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Boston ..... 232 Summer St
Chicago ..... 128 W. Kinzie St.
Cleveland ..... 777 Rockwell Ave.
Dallas, The Texas Chas. A. Schieren Co. Inc ..... 205 So Market St.
Denver ..... 1752 Arapahoe St.
Detroit, Mich ..... 72 Congress St., W.
Kansas City ..... 1324 West 12th St.
Memphis, Tenn. ..... 475 So. Main St.
New Orleans, La. ..... 404-406 Canal St.
Philadelphia ..... 226 North Third St.
Pittsburgh ..... 337 Second Ave.
St. Louis, Mo. ..... 18 So. Broadway
Salt Lake City, Utah ..... 115 W. Second South St.
Seattle, Wash. ..... 305 First Ave., So

Oak Leather Tanneries, Bristol, Tenn.

Long Life Bushings In Spite of Neglect

Oil-less

"NICRUM" (Impregnated Wood) "BOUND BROOK" (Graphite-and-Bronze)

Bushings

Trade Mark Reg. U. S. Pat. Off.

All genuine Graphited Oil-less Bushings have always been made at Bound Brook, U. S. A

BOUND BROOK OIL-LESS BEARING CO.

Bound Brook New Jersey

Specialists in the manufacture of Oil-less Bushings for more than a third of a Century

AWARDED PANAMA PACIFIC GRAND PRIZE INTERNATIONAL EXPOSITION

Americore

RUBBER COVERED WIRE for INTERIOR WIRING

Every coil examined and labeled under the direction of the underwriters laboratories. Ignition wire for autos, motor boats and aeroplanes.

Send for booklet fully describing.

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Outlasts the Belt

Don't be satisfied with makeshift methods and inferior appliances in the matter of making belt joints. Use

CRESCENT BELT FASTENERS

and you'll be in good company and lots of it. Ask us.

CRESCENT BELT FASTENER CO.

381 Fourth Ave. New York, N. Y.

CRESSON-MORRIS CO.

Power Transmitting Machinery

We make a complete line of Power Transmitting Machinery, Shafting, Rope Transmission, Machine Moulded Iron and Steel Gears for heavy service.

Cresson-Morris Company

Engineers—Founders—Machinists

Philadelphia, Pa.

Oil cut down 2/3rds

"This slack belt saves oil"

Formerly these oil cups were filled three or four times a day.

Now the bearings are cool with only one filling.

They didn't change the oil—they let the belt run slack. That took the constant strain off the bearings. The pull is all on one side now, and the pulley *turns* instead of grinding against one side of the bearing.

The increased contact which this slack belt gives, together with the saving in fractional resistance has delivered more power.

CLING-SURFACE BELT PRESERVATIVE has made this possible by keeping the belt healthy.

It is not sticky, contains no rosin, and is safe, easy and economical to use.

Obtain these savings in YOUR plant.

Write today for the 50-lb. can. Test it for 60 days. If satisfied, pay us. If not, there will be absolutely no charge.

Cling-Surface Company

1028 Niagara Street

Buffalo New York

U. S. A.

SUPERLA BRAND

Represents New Process Friction Reducing Oils

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OIL

CYLINDER
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DYNAMO
TURBINE
MACHINE
TRANSFORMER

EVERY DROP COUNTS

Superla Brand Oils assure the highest degree of lubrication at minimum cost. Their adoption by leading industrial works of the world is the strongest proof of superior lubricating value and power saving properties

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A Short Cut to Bigger Pay

The Power Plant Library is a short, sure cut to Bigger Pay. No other Library will do for you what the Power Plant Library will—start you with the simplest principles of power plant work and carry you quickly and surely over every phase of modern power plant operation as it is today—including mathematics, steam, electricity, turbines and refrigeration. Three thousand pages and as many illustrations. Compiled by experts from actual practice. Send for a free ten-day examination now.

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It Doesn't Cause Trouble in Winter

Ordinary grease becomes hard and gummy in cold weather. As a lubricant it is **useless** until frictional heat melts it. Meanwhile power and fuel keep wasting.

TRADE MARK REGISTERED IN
NON-FLUID OIL
UNITED STATES PATENT OFFICE

Never changes its density, therefore is ALWAYS lubricating in ALL weathers. Cold can't harden it; heat can't melt it.

Think of how useful a pure, power-and-fuel-saving lubricant like this will be to you.

Ask for free samples—today.

New York & New Jersey Lubricant Company
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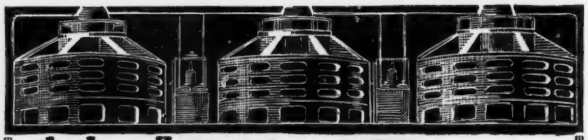

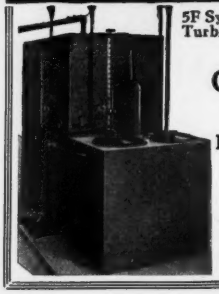

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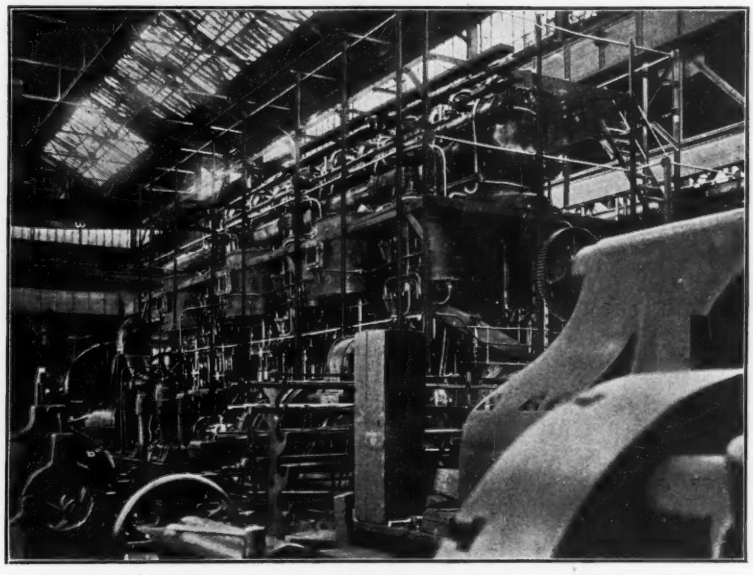

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The Largest DIESEL ENGINE in the World

The engines of the U. S. S. "Maumee," a Naval fuel oil supply ship, are important as an example of engine building and operating efficiency.

Considering the type of engine, these engines may be truly called enormous. They are 43 feet long at the bed-plate and 25 feet high from bed-plate to top of cylinders.

Our view was taken at the New York Navy Yard shops, where these engines were built.

The engines (each consisting of six power cylinders), are rated at 2500 shaft horsepower. They operate independently on individual shafts, the ship being a twin screw vessel.

The engines were given an exhaustive test on the block and were then taken down and erected in the hull of the ship. An extended sea trial equalled the highest expectations of the designers and satisfied all concerned by the splendid performance shown by

TEXACO URSA OIL

the lubricant used on the tests and thereafter, including up to the present writing.

The outstanding features of the performance of TEXACO URSA OIL were the low fuel consumption and the low lubricating oil consumption. This is due to the way URSA maintains the seal between piston rings and cylinder walls.

Another feature which made TEXACO URSA OIL so valuable for use on these huge engines and that makes it of great value to Diesel or Oil Engine users is that it was the only oil used on the entire engines.

TEXACO URSA OIL was used and is used to lubricate the power cylinders, the air compressors and all the bearings. THE ONE OIL FOR ALL.

This eliminates the danger of any mistake in the use of oil. There can be no mistake. One oil for the entire unit. TEXACO URSA OIL has become known as the standard for Diesel engines because of this feature and because it is such a carefully refined, pure lubricant. It burns clean, does not decompose in the cylinders and produces no hard carbon deposits.

Write us for prices or for further information. We shall be glad to answer you fully.

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There is a Texaco Lubricant for Every Purpose.

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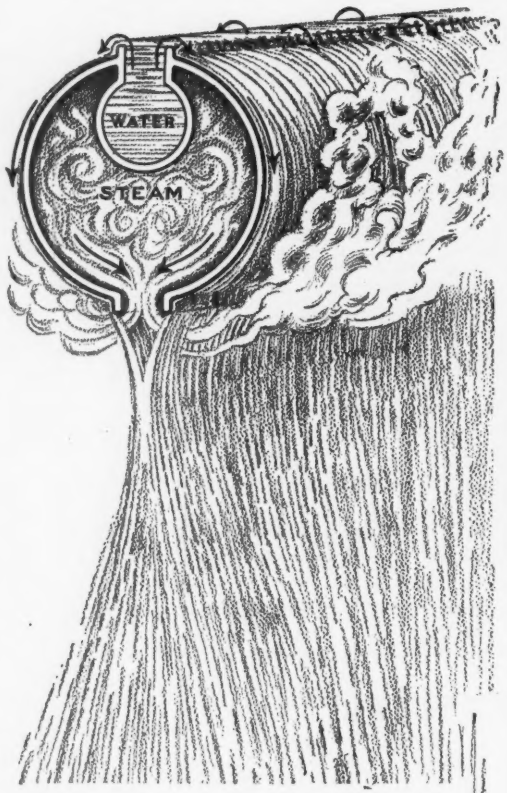

The Real Fuel Saver

No matter how efficient your engines and turbines may be, or how carefully you may watch combustion, you can't possibly get real economy in your power plant unless you heat the feed water with exhaust steam.

NATIONAL
DIRECT CONTACT
FEED WATER HEATERS

provide feed water practically as hot as the exhaust steam because the steam passes through and mingles with the water which leaves the contact pipes in the form of spray.

This heating and upward filtration purifies the water and the large capacity of the shell provides large storage for hot water—you know the advantage of having a good supply of hot water. This heater is also an oil separator, so that there is no chance for oil to enter the boilers.

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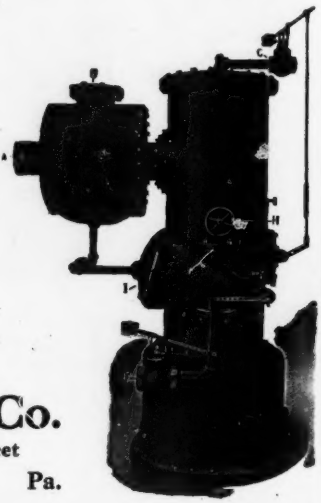
Nothing complicated or bothersome about it. Its round shape enables it to withstand internal pressure, and being made of cast iron, the SIMS Feed Water Heater resists corrosion.

For further particulars send for bulletin O. H. 4 P. E.



The Sims Co.
2001 Holland Street
Erie Pa.

A Costly Steam Pump or This Little Inexpensive

U. S. Automatic Injector—
WHICH SHALL IT BE?

Will you use two pumps or one pump and an injector? There's a mighty big difference between the cost of a pump and the cost of an injector. Think of the saving in eliminating just one pump. Of course, the injector you use will be the U. S. Injector. That's the standard injector throughout the country. Over 400,000 in use.

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American Injector Co.,
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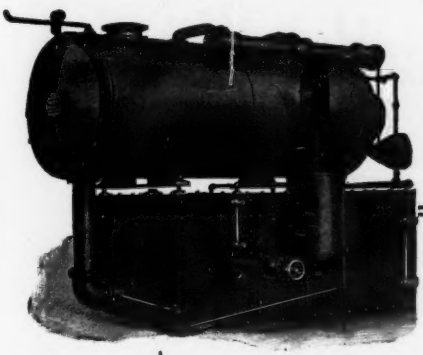


An Ideal Combination for Maximum Efficiency

It is the Hoppes Feed Water Heater connected up to the Hoppes V-Notch Meter, and it is wonderfully effective in reducing operating expense.

After the water has been heated and purified, it passes on to the storage tank below, where it is metered. A record of the rate of flow is made on a circular chart, and the integrator on the opposite side of the head indicates and records the amount of water passed.

HOPPES

Exhaust Heads, Steam and Oil Separators, Live Steam Purifiers, Feed-Water Heaters, Etc.

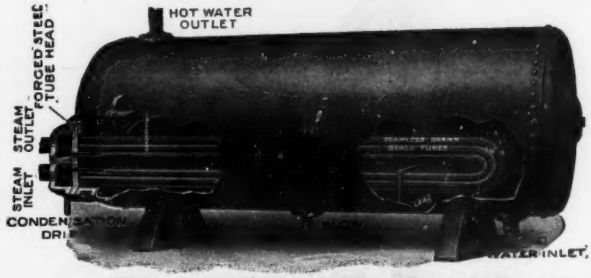
This apparatus will keep an accurate and continuous check on your plant, and you can determine at any time whether or not you are getting the maximum efficiency. There are no floats used in the Hoppes V-Notch Meters and they are just as dependable at a high rate of flow as at a minimum rate.

The Hoppes V-Notch Meters are guaranteed to be accurate within 1½% by weight, for either high or low rates of flow and at any temperature of the water.

Our Catalog No. 50 will be of value to you. It gives illustrations and full descriptions. Write us concerning your requirements. We will gladly figure with you. Our service assures you complete satisfaction.

THE HOPPES MANUFACTURING COMPANY
70 Larch Street, Springfield, Ohio

NO MORE WORRY ABOUT HOT WATER



We have the Hot Water Heaters to supply it in any quantity, at any temperature, and the Engineering knowledge and skill to help you determine just what you need and how to install it most advantageously.

We've Been Hot Water Heating Engineers for 20 Years

All that time we've been meeting and solving all sorts of problems in this line, and the experience thus gained is at your command without charge or obligation. Our line is complete, so we not only can write the correct prescription, but can fill it correctly. Put your hot water heating troubles up to us. Ask for the Patterson Catalog—free.

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"GET-AT-ABLE"

That word describes the particular advantage to the operating engineer of

The Reilly Heater

A door in the shell permits easy inspection of heating surface. Coils are attached to manifolds by union connections free from brazing. Coils are interchangeable.

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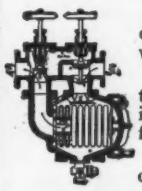
THE GRISCOM-RUSSELL CO.
2141 West St. Building, NEW YORK
Boston Philadelphia San Francisco Chicago

KEEP OUT OIL



The function of this filter is to prevent oil getting into your boilers and is used wherever a condenser is used.

It is quickly cleaned by merely shutting by-pass and operating valve. Filtering media may be entirely removed in five minutes.

Send for illustrated circular, giving details and list of principal owners.

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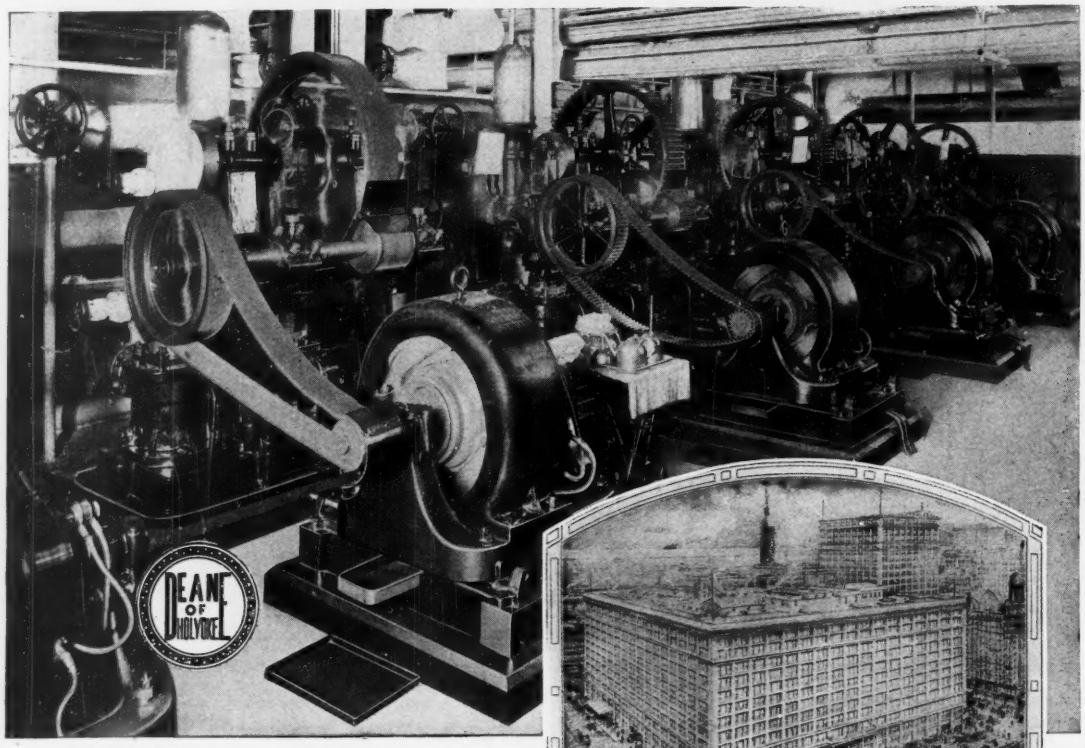
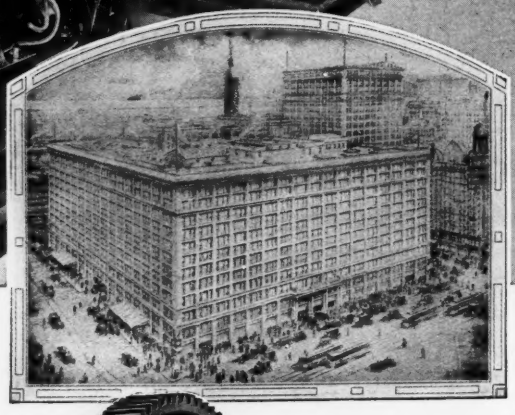




DEANE

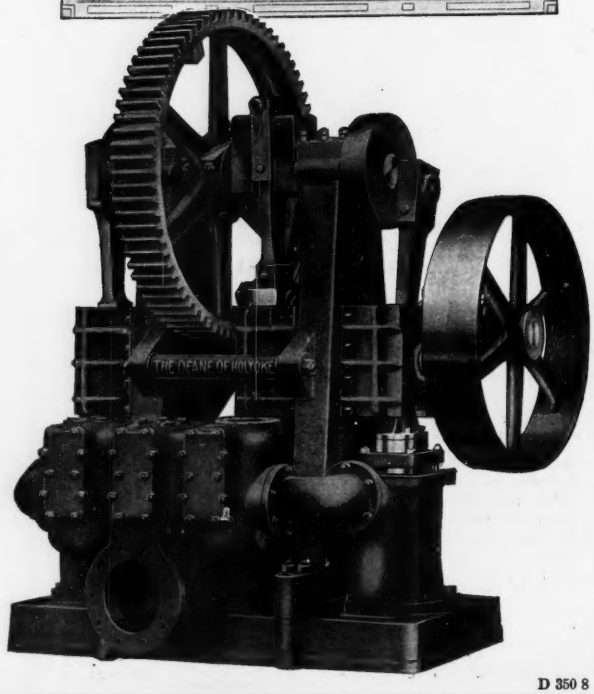
of Holyoke, Mass.

POWER PUMPS

furnish the entire water supply for the world's largest department store.

Marshall Field & Co.'s Chicago building depends on five Deane of Holyoke Power Pumps for its water supply. Four of the pumps have been in service over ten years. The fifth pump was installed two years ago.

In this great structure, Deane of Holyoke Pumps are furnishing a striking example of dependable and efficient service. You, too, can rely on Deane Pumps for your pumping requirements.



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WORTHINGTON PUMP AND MACHINERY CORPORATION
115 Broadway, New York
Deane Works, Holyoke, Mass.
Branch Offices in all Principal Cities

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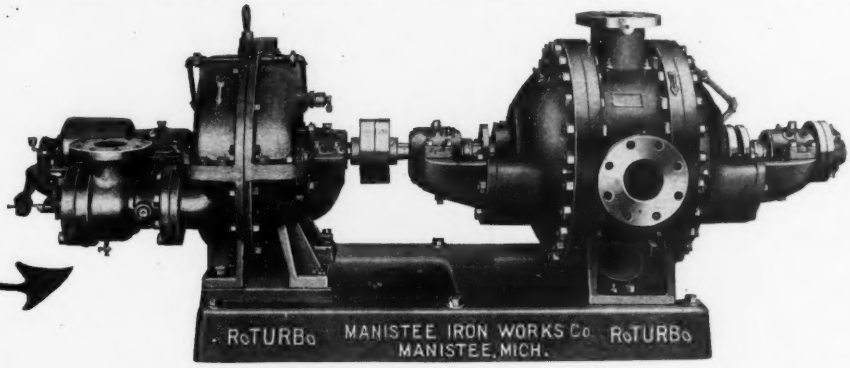
Eliminates Pump Governors Saves Governor Troubles.

You know what pump governors cost—Save that money—You know there's pump governor maintenance to be considered beside the additional possibility of trouble—Save that maintenance cost and trouble by installing the REES-RoTURBo Boiler Feed Pump. It can be regulated for variable volumes of delivery by the simple adjustment of the boiler check valves or the main valve. The motor will not be overloaded by the pump at constant speed, even though the boiler pressure falls—nor will the pump or mains suffer if all the main or all the check valves are closed suddenly while the pump is running at full speed. We'd like to tell you all the advantages of the REES-RoTURBo Boiler Feed Pump. Write us today.

MANISTEE IRON WORKS, Manistee, Mich.



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The Boiler Metal Treatment

The Modern Method of Boiler Scale Removal and Prevention

Removes Scale by Mechanical Expansion

See me "Expand" in next issue

Perolin Co. of America
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Waste or Service

Here, in one hose (and only one), is the endurance of metal and the flexibility of rubber. Both material and construction are fitted to their purpose. Use is not waste with such a hose. Use means service—long service, economical service.

If you are wasting hose in the vain solution of a hose problem, why not find out what service is possible under the circumstances? That only necessitates writing us.

The American Metal Hose Co.
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Covers the construction and operation of stationary, locomotive, and marine engines and boilers; the use of gas and gasoline engines for power and locomotion; the transformation of steam and gas power into electricity, and the application of steam and gas power to refrigeration, compressed air, etc.

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12 Page Booklet "Feeding Boilers" Sent Free to Engineers on Request

Do you know how much it costs to feed your boilers with steam pumps? Do you realize that in many cases your steam boiler feeders are using more steam than the engine which drives your entire plant? If you have not given these matters much attention, you will find plenty of food for thought after reading a comparison of the operating costs between direct-acting steam pumps and

DEMING

POWER PUMPS

We will be glad to send our interesting little booklet to any licensed engineer. The comparative tests made at the St. Louis Exposition, which are mentioned in this treatise, are sure to be interesting to every engineer. And if you have any kind of a pumping proposition in view, tell us about that, too, and our engineering department will be glad to forward advice.

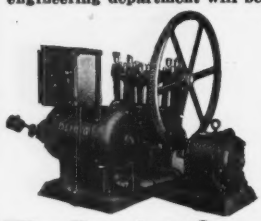

Figure 98—Type B

To drain automatically steam coils, radiators, heaters, etc., of the water of condensation constantly collecting there and to return this water to the boiler at a temperature otherwise impossible without the use of a special water heater.

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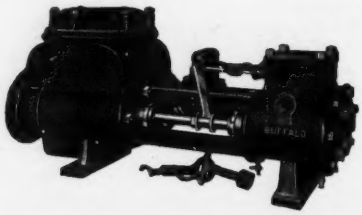


For Immediate Shipment

We have ready for immediate shipment, a stock of

"Buffalo"

Boiler Feed Pumps

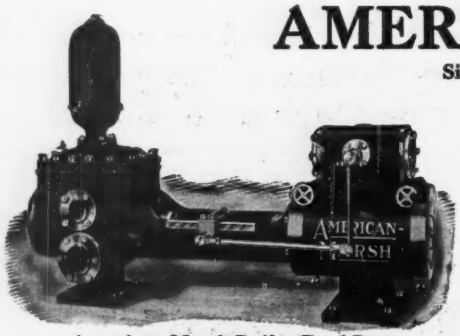
If you want prompt delivery on this type of equipment—may we take care of you?

Buffalo Steam Pump Company

Buffalo, N. Y.

AMERICAN-MARSH PUMPS

Simplex Not Duplex: "To be Simple is to be Great"



American-Marsh Boiler Feed Pump

American-Marsh Pumps are especially adapted for hard service as they are extra heavy in design and of extremely rigid construction. Every unit is built amply strong to withstand 24-hour-a-day service and to stand up under any unforseen strain which may be placed upon it. Solid bronze piston rods and cast bronze removable water cylinder bushings are regularly furnished. American-Marsh Pumps are the product of over 25 years' experience in the design and construction of high grade pumping machinery.

Ask for special bulletin covering type in which you are interested.

American Steam Pump Co., Battle Creek, Mich.

Manufacturers of Steam and Power Pumps and Air Compressors

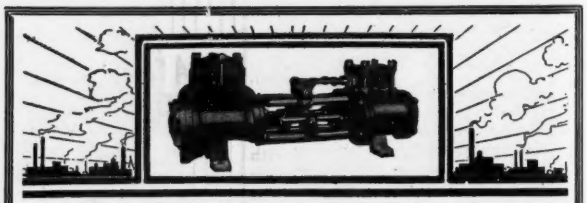
Spraco Cooling Systems

These systems are highly efficient in cooling condensing water. The maintaining of a 28-inch vacuum the year 'round is assured. Installing the SPRACO systems is an easy matter and both installing and maintaining cost is low when compared with other cooling systems.

SPRACO COOLING SYSTEMS can be installed on the ground or on the roof of building. A request for our interesting literature will receive prompt attention.

THE SPRAY ENGINEERING CO.

93 Federal St. **Boston, Mass.**



THE VALVE MOVEMENT

of DEAN BROS. DURABLE DUPLEX STEAM PUMP is the most important improvement that has been made on a duplex steam pump for twenty-five years.

Send for Catalog No. 106

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NOT IN THE PUMP TRUST.

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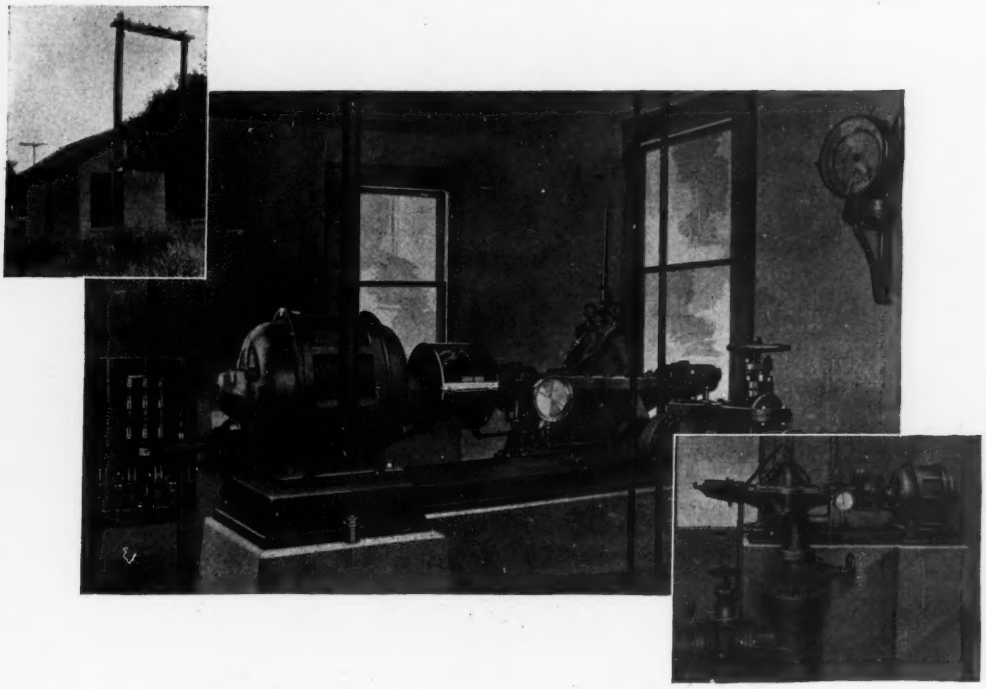

Reducing the Power Cost by a Remotely Controlled Waterworks Pumping Unit

Fort Atkinson, Wis., had been pumping water with steam, but was able to get a low rate for electrical power transmitted from Milwaukee.

About a year ago they put in at the main pumping station an electrically driven "American" 4-inch single stage, double suction, bronze fitted, horizontal centrifugal pump having a daily capacity of 1,000,000 gallons against a total head of 175 feet when operating at 1750 r. p. m.

The performance of this unit was so satisfactory that the city decided to make a further saving in power by putting in an auxiliary pumping plant to remove the peak load and thus obtain a lower rate for power.

The city owns a flowing well, located about 4000 feet from the central pumping station. At this well was installed an "American" 2½-inch, horizontal, single stage, double suction, bronze fitted, centrifugal pump operated by a 20 h. p., 3 phase, 60 cycle, 220 volt, squirrel cage type, 1800 r. p. m. General Electric motor and having a capacity of 310 g. p. m. against a total head of 180 feet. The duty of this pump was to deliver water to an elevated storage tank.

In addition to the transmission line between the main station and the small auxiliary plant a single No. 10 iron wire was strung to control the equipment. A Sundh Electric Co.'s control panel for operating the motor was placed in the new plant. At each end of the control line is a single pole, double throw knife-switch so arranged that the equipment can be operated from either end of the line. By throwing the knife-switch in the other direction from the one in which it was not operating the pilot light would glow, showing the pump in operation, and so long as the lamp was lighted the operator knew the pump was in service.

The performance of this plant was so perfect that during the first month of service it was not visited by the operator in the main station.

A G. E. flow meter is attached to the discharge of the pump and this indicates that there is an over all efficiency between the power charged to the pumping plant and the net amount of water pumped into the mains of approximately 50 percent. This economy is only made possible by the high efficiency and great reliability of the pump.

Write for catalog 149 describing this and over 50 other styles of "American" centrifugals.

The American Well Works

General Office and Works: Aurora, Illinois, U. S. A.
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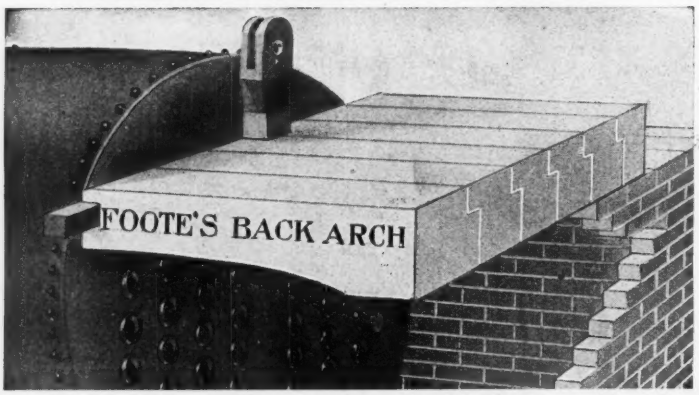
Install This Back Arch



Neither Time Nor Money Need Be Spent On It Again

Any one can put it up so it will last as long as the boiler. That means cutting out the cost of repairs on this part of your boiler setting. Barring accident, it need never be taken down.

It is simple and strong—independently supported, heat proof, and gas tight. There is head room under it so you can work in the combustion chamber.

If you have horizontal tubular boilers, you ought to have Foote's Back arches on them. Write for a "Measurement Booklet" and let us tell you the price. We ship at once.

"STEEL MIXTURE"

McLeod & Henry Co., Troy, N. Y.

Boston Office—141 Milk Street New York Office—1402 Broadway

Front wall of Betson's formed up to the arches, showing rough temporary forms for the arches in place.

If You Can't Spare the Boiler for Furnace Repairs

REG. U.S. TRADE MARK PAT. OFF.

PLASTIC FIRE BRICK

Will Do the Trick

IF there are holes or cracks in your fire brick lining, ram in a chunk of Betson's stuck on the end of a rod or poker from the fire doors, without shutting down.

If a part of the side walls burns out, arches or front fall down, the easiest and quickest repair is to fill in with Betson's.

When the whole lining must be renewed, put in a complete one-piece lining of Betson's Plastic Fire Brick. Anyone can do it and as soon as the job is completed, dry under a low fire for 5 or 6 hours and put the boiler into commission. A Betson lining is installed and in service in a much shorter time than is possible with a laid-up brick lining, and it will last years with a minimum of repairs.

Send for a barrel of Betson's for repair purposes, and you will eventually reline completely with Betson's.

Write for Bulletin PE.

Betson Plastic Fire Brick Co. P. O. Box 1386 Rome, N. Y.

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For bonding and repairing fire clay or silica brick work, tile, retorts, crucibles, etc.

USE **HYTEMPITE** THE

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High Temperature Fire Brick Cement.

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Manufacturers of

Highest Grade Fire Brick
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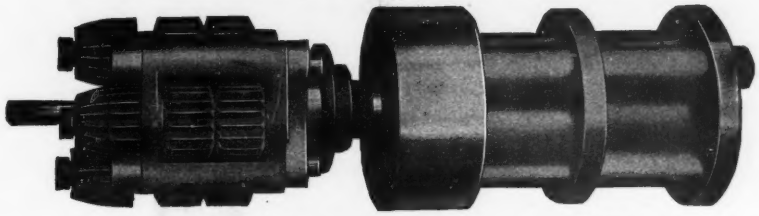
Plants in Pennsylvania, Ohio, Kentucky, Indiana and Alabama

ROTO TUBE CLEANERS

The most effective scale removing tools made



Tube Cleaners Driven by Air or Steam and by Water

For Cleaning

Boilers of All Makes — Fuel Economizers — Locomotive Arch Tubes
Feed-Water Heaters — Condensers, Heaters, Evaporators, etc.

Standard of the Leading Power Plants
Catalogs Sent On Request

The Roto Company **Hartford, Conn.**

A Real Fuel Saver

Sent on Trial

The Tornado Boiler Tube Cleaner Does the Work with Dry Air
by just using enough steam through ½-inch hose to secure a strong, continuous blast. More efficient and economical than scraper or brush.

The Paul B. Huyette Co., Inc., Suite 3, No. 5 South 18th Street, **Philadelphia, Pa.**

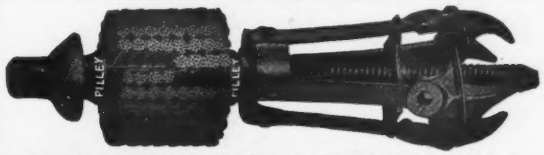
Farley Flue Cleaner— It Cleans Clean

The flat steel wires remove every particle of dirt and soot from the flue. Used wherever a positive draft is needed.

"Fill-In" Steel Cement

Don't take down that leaky piping! Simply insert a little "Fill-In," allow a few hours—and the piping is absolutely tight. A sample can—that will prove it—for 25c.

J. W. Paxson Co., "Dept. C."
1021 N. Delaware Ave., Philadelphia, Pa.



Looks like a good tool and it's just a little better than it looks. Adopted as standard by thousands of engineers who know from experience that it always gets results.

Pilley Combination Flue Brush and Scraper

is adjustable to the tube—scrapes and brushes thoroughly in one operation. Guaranteed against defective materials and that wires will not pull out or lay over. Dealers can supply you or we will ship direct from factory or New York office.

Eastern Office: 71 Fulton St., New York.

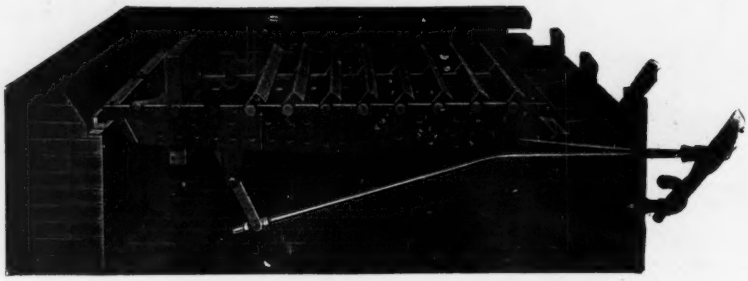
Pilley Packing and Flue Brush Mfg. Co.
611 South Third Street ST. LOUIS, MO.

KELLY GRATES GOSHEN IND.

Your Power Plant Is the Heart of Your Factory

KELLY GRATES GOSHEN IND.

Easy To Install



Easy To Operate

Plate No. 22 Style "B"

WHEN a lot of rush orders make it necessary to speed up production and run your factory to its fullest capacity, your power plant must meet all over-loads.

KELLY ROCKING AND DUMPING GRATES will increase the efficiency of your boilers and do it economically.

KELLY GRATES are substantially built from that grade of iron that will best resist heat and will burn successfully any grade of coal on the market.

Every set of Kelly Grates is guaranteed to give absolute satisfaction in the strictest sense of the word.

Made any length, any width at no additional cost. Simple to install and easy to operate.

When you buy KELLY GRATES you buy results.

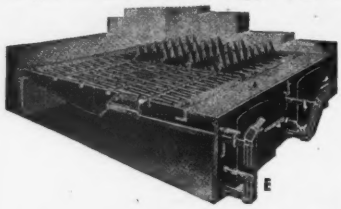
Write for Grate Catalogue "C."

The Kelly Foundry & Machine Company, Goshen, Ind.

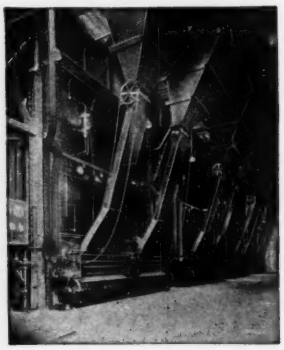
Established 1887 Power Plant Engineers 617 Ninth Street

Seeing is Believing

Talk is cheap. Anyone can say "Best" and "Just as good." Real merit wins. That's why we do not hesitate to place the ARMSTRONG Grate in on trial alongside of any shaking grate or stoker on the market at our expense. Past experience has taught us that engineers appreciate the features of an ash sifter, vibrating grate, shaking grate and dumping grate combined as a single unit in Armstrong Grates. A grate that is a proven coal and time saver cannot be ignored. Your first move toward coal conservation is the sending for our literature.



Armstrong Manufacturing Co. 252 Ludlow Ave., Springfield, Ohio.



LINK-BELT Equipment

for

Boiler Plant Efficiency

Machinery for handling Coal and Ashes
Conveyors Coal Crushers
Traveling Weighing Hoppers
Spouts: Locomotive Cranes
Water-Intake Screens
Silent Chain Drives
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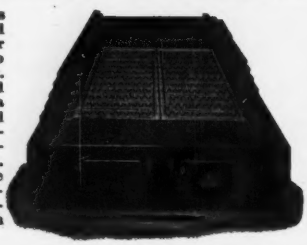
LINK-BELT COMPANY

Philadelphia Chicago Indianapolis

It's Weight Makes It Durable

The "Shear-Klean" is heavily constructed and the frame-work is far enough from fire line to be protection from heat. It's a lasting Grate, and the only one having a "sidewise shearing" and "crushing" action in addition to its rocking motion. Ask us all about it. We'll furnish you all the information desired, together with our fine Catalog "Efficiency," filled with power plant knowledge.



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MARION, INDIANA P. O. BOX 400

CHICAGO, ILLINOIS 505 MONADNOCK BLOCK

The MODERN WAY of Handling ASHES is by the

GECO STEAM JET SYSTEM

Dustless, Simple, Reliable, Economical, Safe

GREEN ENGINEERING COMPANY

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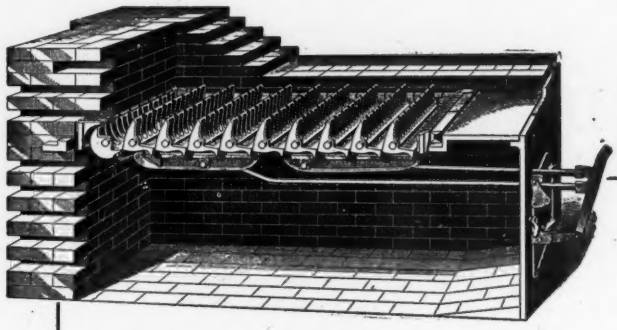
PATENTED GECO APPLIANCES

Bulletin No. 1 Green Chain Grate Stokers
Bulletin No. 2 Geco Steam Jet Ash Conveyors

A Money-Saving Team
The McClave Grate and the Argand Blower



Fuel Waste Is Making Big Inroads Into Your Profits

Hitch this team to your combustion system and it will pull it out of this rut. Give it the right-of-way, and it will burn your fuel the right way—without wasting any good fuel into the ash-pit—without reducing the capacity of the boiler a fraction of a horsepower—without causing your plant to suffer any depreciation in service whatsoever, but rather effecting a marked increase in efficiency.

And this is accomplished with slack, screenings or any other cheap coal.

No back-tiring toil with **McClave Grates.** Outside lever-operated shaking and dumping movements—minimum upkeep expense because of removable sectional top construction.

The **Argand Blower** furnishes a properly proportioned, combined air and steam blast which keeps any clinker comparatively soft and porous, so the draft can percolate through the entire bed of fuel uniformly. We guarantee that it will induct more air with less steam and make less noise than any other steam blower on the market.

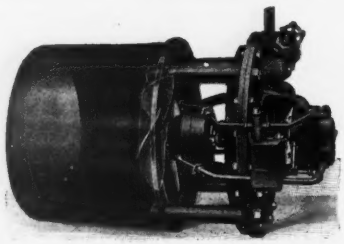
Catalog "D" tells about this money-saving team. Goes into detail.

Ask for it today

McClave-Brooks Co.

Scranton, Pa.

New York, 50 Church St., S. C. Smith, Mgr.
Chicago, 515 Hearst Bldg., F. G. Smith, Mgr.



Any Old Coal Will Do

for the boiler furnace whose draft is supplied by a Wing blower, because the

The Original **Wing** Turbine Blower The Standard

is a simple and easily installed application of the principles of forced draft. The Wing Blower will get every possible heat unit out of the cheapest of fuels, will give you more pounds of steam per pound of coal and increase your boiler capacity by from 25% to 100%. We say the Wing Blower will do all these things because it has. We'll be glad to give you a definite idea of what it will do in your plant, if you will send us the necessary data, and install a Wing Blower under specific guarantee. Ask for the Wing Blower Book.

L. J. Wing Mfg. Co.

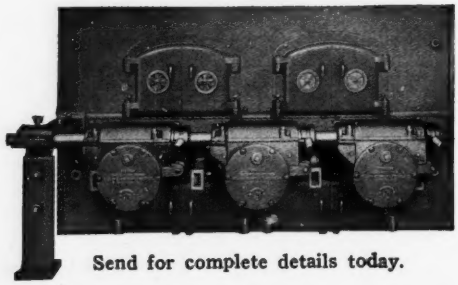
659-669 Hudson Street - - New York

Manufacturers of Ventilating Fans, Blowers, Damper Regulators, Feed Water Regulators, Pressure Blowers, Vacuum Pumps and Small Turbines.

STEVENS
UNDERFEED STOKER

The "STEVENS" is suitable for any sized furnace. Your fuel bills will be reduced, as any grade of soft coal can be burned with entire satisfaction. An even fire over entire grate will give you full boiler capacity without forcing the draft.

Smoke is eliminated. The "STEVENS" requires only 24 inches of floor space and can be installed in forty-eight hours without tearing down side walls or bridge wall.



Send for complete details today.

Nelson Blower & Furnace Co.

14 Elkins St. S. Boston, Mass.

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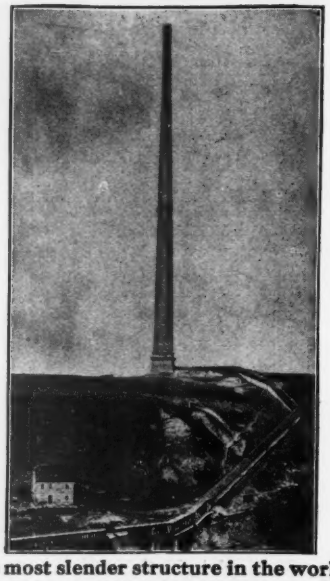
RADIAL BRICK



COMMON BRICK

The most slender structure in the world—
a Heinicke Chimney 460 ft. High by 8 ft. 3 in. dia. at top

H. R. HEINICKE, Inc.

147 Fourth Avenue New York City

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STOKERS

The Stoker with the Reciprocating Retort Sides

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Mechanical Stoker Performance

Stationary Grate Upkeep

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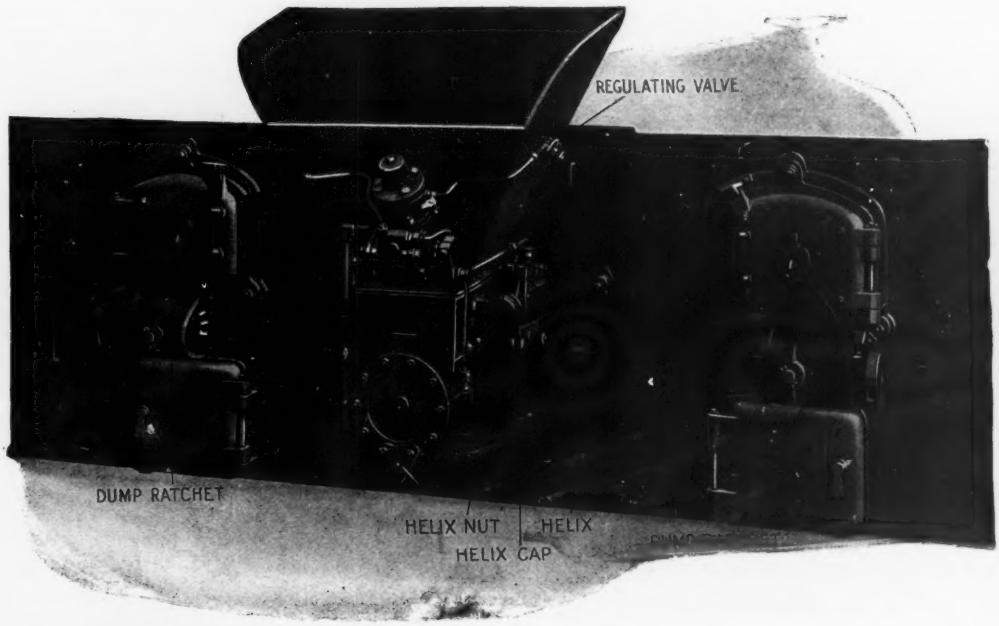
Fuel and Labor Shortage

Met and offset by

Type E Stokers

Quickly Installed—High Capacity
Easy to Operate

Get in touch with us for full information



COMBUSTION ENGINEERING CORPORATION NEW YORK

Combustion Engineering Corporation
New York City, 11 Broadway

Owners and Manufacturers of
Type E Stokers—Bituminous Coal
Coxe Stokers—Anthracite Coal and Coke Breeze
Grieve Grates—Hand Firing

PHILADELPHIA, PA.
PITTSBURGH, PA.
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HAZLETON, PA.
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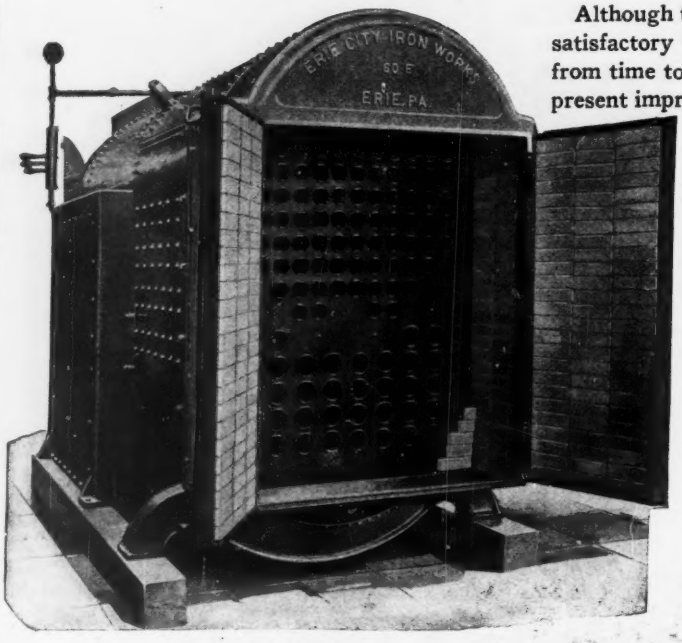
SEATTLE, WASH.

The Improved "Economic" Boilers



Although the first "Economic" Boilers proved highly satisfactory 20 years ago, they have been improved from time to time, which makes us justly proud of the present improved type of the "Economic" Boilers.

They are portable, safe, durable, and take up little floor space. The combustion of the fuel is excellent. Steel casing plates prevent heat waste and keep out cooling drafts of air. The tapered bricks are made especially for us and are protected by our own patents. They allow sufficient air space to prevent excessive radiation of heat from outside furnace walls and warping of the casing plates. The boiler can be shipped complete with grates and fire bricks in place.

Our bulletin is sure to interest you. Send for it today.

Erie City Iron Works, Erie Pa.

Babcock & Wilcox—Stirling—Rust

Water Tube Steam Boilers

Steam Superheaters **Mechanical Stokers**

The Babcock & Wilcox Company

85 Liberty Street, New York **Works: Barberton, Ohio; Bayonne, New Jersey**

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Los Angeles....American Bank Building
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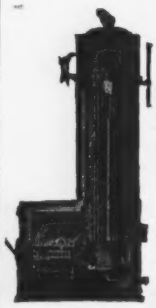
Philadelphia..North American Building
Pittsburgh...Farmers' Deposit Bk. Bldg.
Salt Lake City.....313 Atlas Block
San Francisco.....Sheldon Building
Seattle .....Mutual Life Building



WICKES
VERTICAL WATER TUBE
BOILER

Ask us why engines are never wrecked and steam turbines never have eroded and clogged blades and nozzles when using this boiler?

Ask us for full data—sent Free

The Wickes Boiler Company
Saginaw, Michigan

New York City, 1417 West St. Bldg. Buffalo, 269 Richmond Ave. Chicago, 76 West Monroe St. Pittsburgh, 904-5 Empire Bldg. Boston, 201 Devonshire St. Detroit 1116 Penobscot Bldg. Seattle, 410 White Bldg.

WHY are you burning such expensive coal? **WHEN** you can burn the cheapest fuel available by equipping your boilers with a

Coppus Turbo Blower

The blower will pay for itself in a short while. As much as 60% saving has been obtained by its use and 25% saving is very common. Furthermore, you do not need to worry about your poor draft, lack of boiler capacity and inability to keep up steam pressure. All these troubles are remedied by the Coppus.

Cut out this Ad, put your name and address on the margin and mail to us you will get all the particulars. We equipped more than half a million boiler hp. in four years.

Coppus Engineering & Equipment Company
159 Union Street, Worcester, Mass.

"Just About Boilers"

Christmas Is Near

You will be so busy buying things for your loved ones that you will not have much time to think of Boilers during the next few days.

But, remember that, as Christmas Day is to other days, so is the

Badenhausen Boiler

compared to other boilers. There is no other "just as good."

We Wish You and Yours

A Merry Christmas

and

A Happy New Year

Badenhausen Co.

Main Office
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Pacific Coast Branch
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San Francisco, Cal.

British Columbia Branch:
Taylor Engineering Co., Ltd., Vancouver

Perfect Circulation
Dry Steam
Minimum Cost of Installation
Low Maintenance Cost

These are combined in the Union Water Tube Boiler and make it the practical, economical, and efficient boiler for the modern power plant.

The efficiency of a boiler depends largely on unrestricted circulation and ability to keep boiler clean while in operation. Our purifier takes out deposits before feed water reaches heating surfaces, and practical provisions are made for cleaning fire side of Union boilers.

Large area of corrugated flange and neck piece connection from drums to header, patent purifier in drums, not exposed to fire, tube spacing is vertically staggered and in horizontal rows to facilitate cleaning, the construction of the handhole and yoke for the plate are distinctive features.

Dry steam is assured by the large steam disengaging surface and storage capacity and method of delivering the feed water.

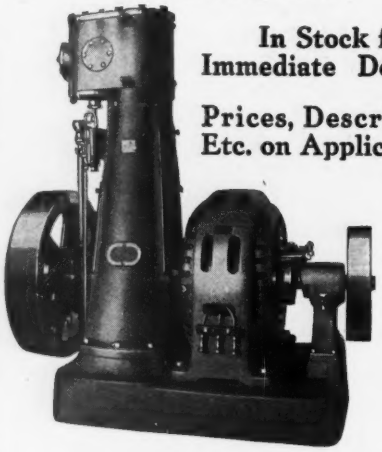
Write and let us tell you about its low upkeep and how easy and inexpensively it is installed. Write today.

Union Iron Works
Erie, Penna.

The Standard for Efficiency Durability Service

For Sale

One 20 K. V. A. Direct Connected Generating Set.



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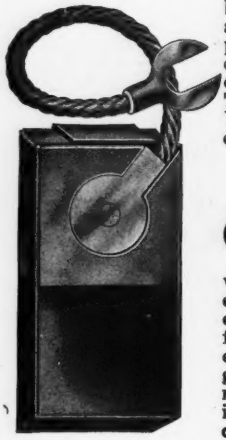
Readers of Power Plant Engineering



will appreciate our new Catalog. because it's something more than a catalog. It is an intensely practical book of scientific data on carbon brushes, compiled from data supplied by the Electrical Testing Laboratories of New York City. The information it contains on

LeValley Carbon Brushes

will be no less appreciated, because it will enable you to choose exactly the RIGHT carbon brush for your particular needs, whatever they may be—a brush so good that we GUARANTEE it not to spark, cut, heat or crumble in service. Positively self-lubricating, too.

Write for your copy of this book. It will be a valuable addition to your technical library.

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522 West 23rd St., New York City

A Positive Cure

For Reciprocating Engines' Chronic Complaint

The hereditary complaint with reciprocating engines is cylinder trouble, excessive friction, wear and scoring. Why stand the expense, worry, delay and labor necessitated by this chronic ailment? Get it out of the engine's system.

Surely you have heard of what GENUINE ALLAN METAL has accomplished in overcoming these troubles? It has been applied to thousands of pistons, under all service conditions, giving entire satisfaction.

Remember the brand, ALLAN: It's the ORIGINAL, the ONLY genuine red metal. Insist on having it. Unscrupulous imitators do not substitute their crude imitations because they believe that it possesses the merits of GENUINE ALLAN METAL, but because they thereby increase their profit at your expense and the standard of efficiency you EXPECTED to receive is of minor concern to them. We brand every segment casting on the concave side, ALLAN METAL. This is done to protect you and our reputation. This brand has stood for efficiency since 1891.

Let's send you our 16 by 26-inch blue print, which shows in detail the application of Allan Metal to pistons and states the advantages derived thereby.

A. ALLAN & SON
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DUNTLEY Universal Electric Drills

Operate interchangeably on direct or alternating current. Attach to ordinary lamp socket. Made in a wide variety of sizes and styles. We also manufacture DUNTLEY Electric Grinders, Hoists and Hammers.

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VERTICAL WINCH

Used for pulling freight cars and for all kinds of hauling, such as helping teams up grades, pulling heavy trucks into and out of steamships, at docks and ferries, etc.

Winches or Winding Drums equipped with either D.C. or A.C. Motor.

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OF GENERAL ELECTRIC COMPANY
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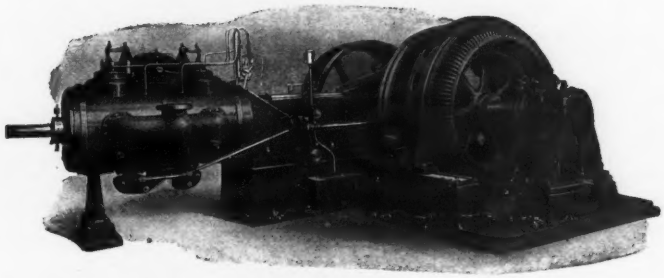
"The Most Economical Steam Engine Ever Built"



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"UNIVERSAL UNAFLOW" engines have been installed on the fuel-saving basis against Corliss, High-Speed Four-Valve and Tandem-Compound Engines.

The "UNIVERSAL UNAFLOW" is the only engine the Central Station fears.

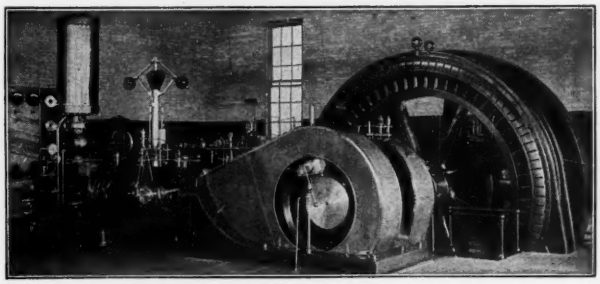
If you want to save your plant from the Central Station, write us.

Bulletin on Request

SKINNER ENGINE COMPANY
Erie, Pa.

Branches In All Principal Cities

HAMILTON CORLISS ENGINES



"The Standard of Merit"

Are universally recognized as "Standard of Merit" and are found in every manufacturing center the world over, because they combine economy, durability and reliability to the utmost degree. Let us serve you, thereby giving you the benefit of our extensive experience covering a period of over forty years. Write for Bulletin P.E.

The Hooven, Owens, Rentschler Co.
Hamilton Corliss Engine Works Hamilton, Ohio
Offices in All Large Cities

A MODERN POWER PLANT

BALL

Non-Releasing Gear Corliss Engines Direct-Connected to Alternators

ECONOMICAL RELIABLE

Ball Engine Company, Erie, Pa.

RIDGWAY
Dynamo & Engine Co.

RIDGWAY, PENNSYLVANIA

Steam Engines Steam Turbines
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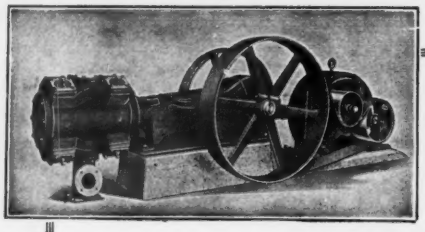
Motor-Generators

High Grade Power Plant Equipment
Ask for Bulletins



NOW IS THE TIME

For you to act quickly in installing the air compressor you've been needing.

"Ingersoll-Rogler" Small Compressors

Are being built for practically immediate delivery in quantities that assures your obtaining the size you want.

They are high grade machines—efficient, long lived and inexpensively operated.

You can do no better than place one in your plant now.

Ask for a copy of "Inside Facts"

INGERSOLL-RAND COMPANY

11 Broadway, New York **Offices the World Over**

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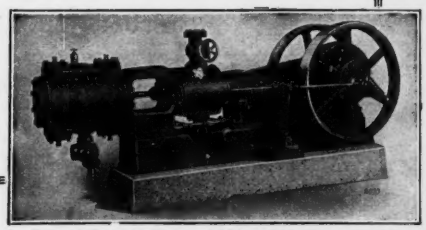

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They have increased their purchases of Allis-Chalmers centrifugal pumps fivefold.

The reason is—they find Allis-Chalmers centrifugal pumps reliable and very efficient.

Our engineering service, based on years of experience, eliminates worry for the purchaser—insures pumps suited for the existing conditions.

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